THE INDEPENDENT GUIDE TO PERSONAL COMPUTING JUNE 27, 1995 VOL. 14 NO. 12 U.S. $3.95 / CAN. $4.95 / U.K. £2.95 ZD

PC MAGAZINE

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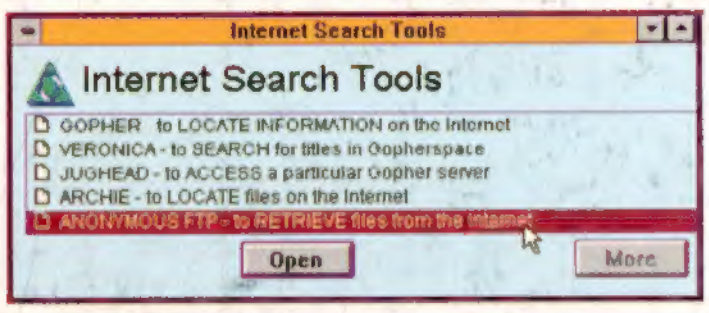

First Looks at the New Web Browsers From America Online, CompuServe, & Prodigy

NETWORK EDITION

To Protect & Serve: 14 File Servers Focus on Safety & Management

Lotus Notes: Which Operating-System Platform Runs It Best?

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THE TOP 100 CD-ROMS

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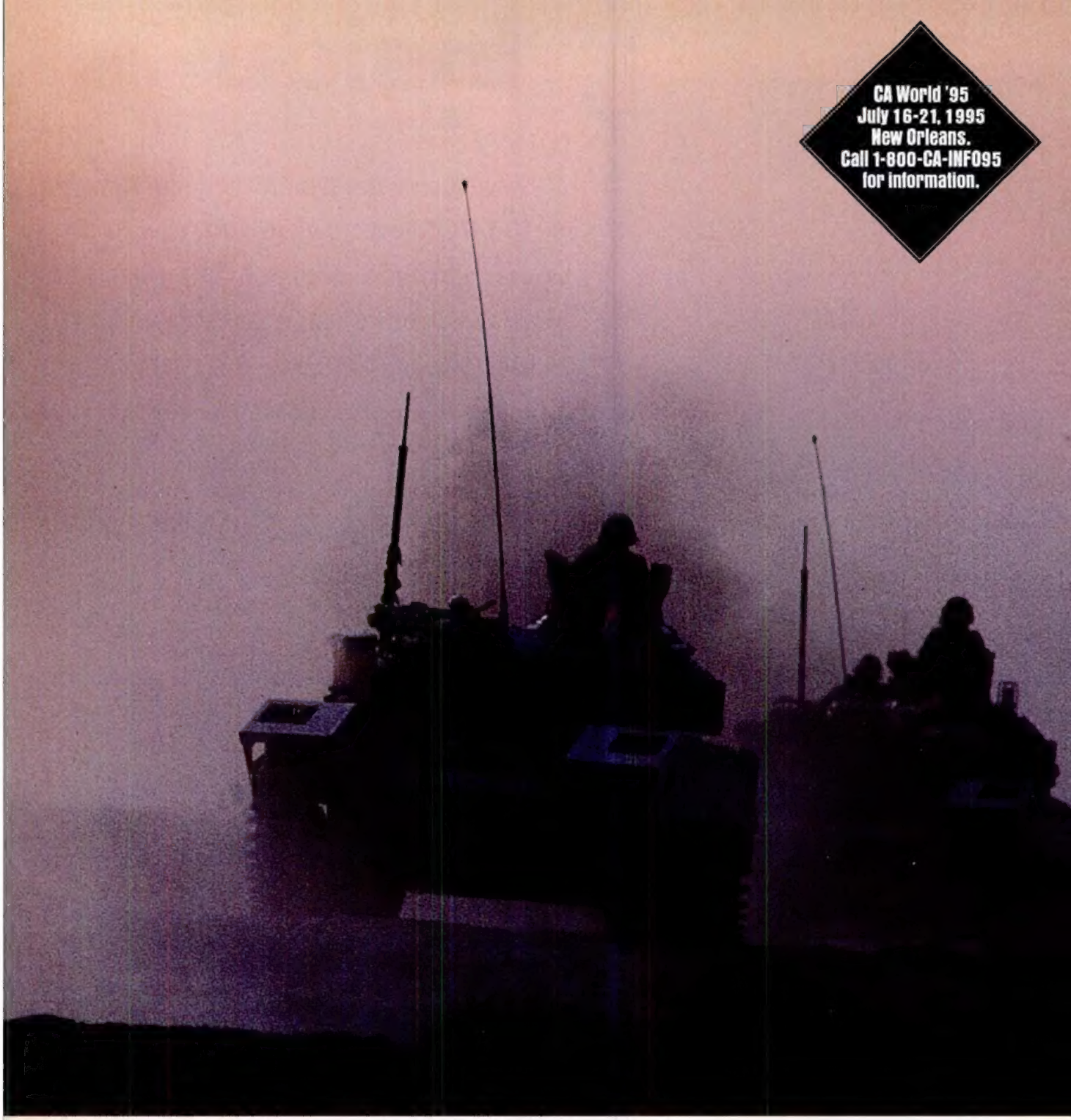

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Inside

In 1994, when we last handpicked our top 100 CD-ROMs, there were 3,000 CDs to choose from on the market.

One year later we're at it again, and that count has soared to 10,000. Our job here is obviously to sort through what one friend calls the "multimediocrity" and identify the titles that represent the industry's best. And stellar content wasn't our only criterion. To receive our nomination, the products had to work as advertised, with easy installation, well-behaved multimedia elements, and a sensible interface. In February, when we started planning the story, we quickly honed the list from 10,000 to 400 by eliminating the old, the niche/vertical, and the plain old uninteresting and distributed the remainder to 33 of our editors. Only after we looked at all 400 did we make the final cut.

As with most of our stories, the testing took place in PC Magazine Labs. And while at times the labs began to look and sound like an arcade parlor, our staff was hard at work evaluating titles that ranged from phone books to cookbooks, from learning ABCs to learning Japanese. Keep these pages near as you make your CD buy.

Associate editor Lance Ulanoff (front row, second from the left), staff editor Kathleen Caster, and researcher Eryn Brown put Patton to shame with their execution of the battle plan for this story. Throughout the story, invaluable "Quick Spins" offer hints, tips, and insights into CD life. If you really want to get the most out of today's multimedia CDs, check out this issue's roundup of graphics accelerators, "Ultrafast Graphics: The Professional's Choice."

So here's to another year of silver-platter computing!

—*Robin Raskin*

Disks were spinning—and so were heads—when we tested 400 CD-ROMs.

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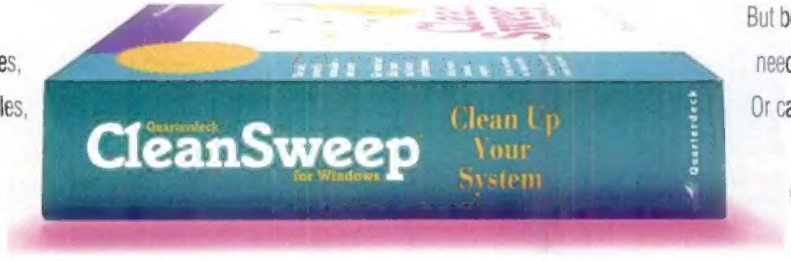

It also lets you view any file, confirm every action, undo anything you've done and even perform trial runs to see how much disk space you're about to gain.

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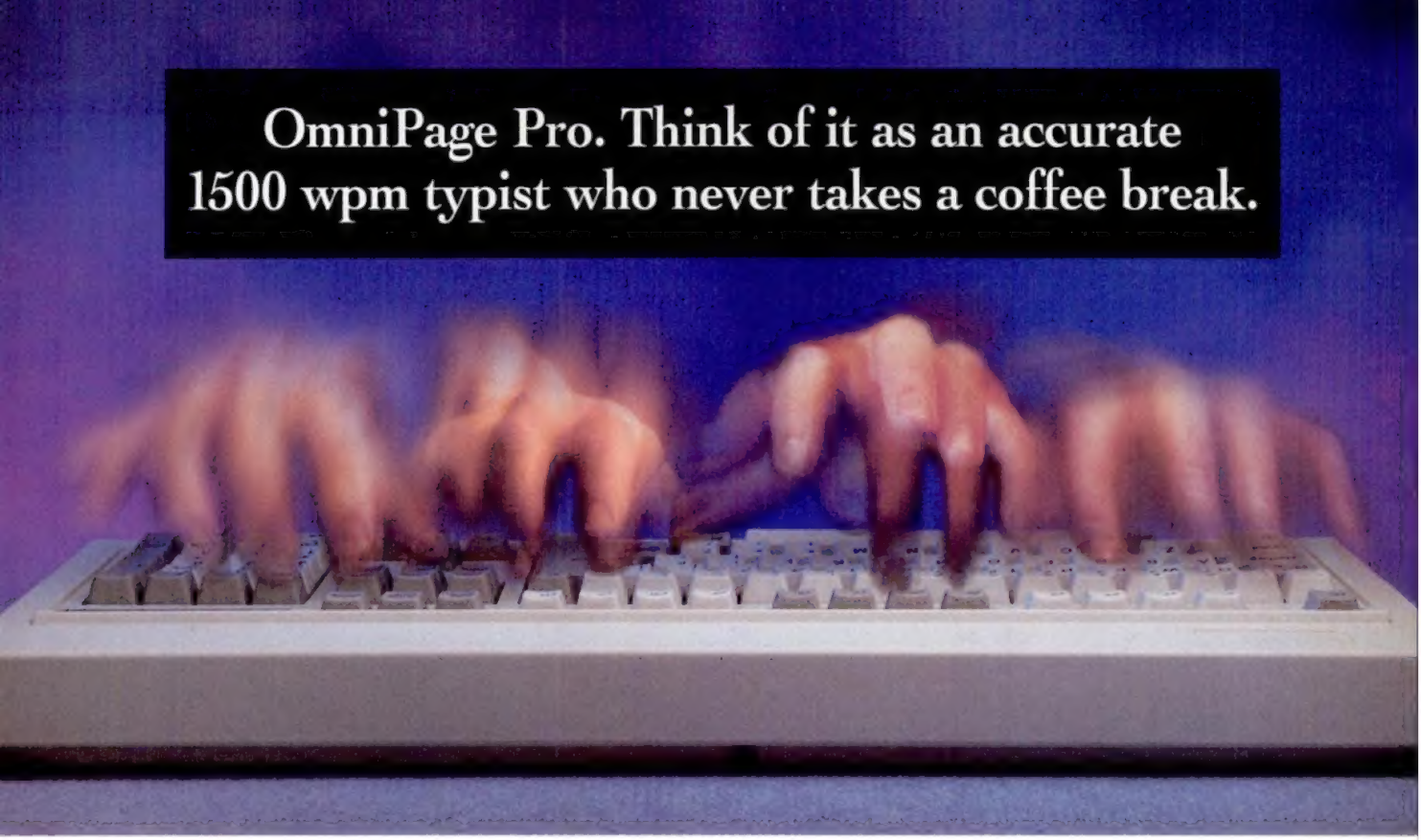

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CIRCLE 292 ON READER SERVICE CARD

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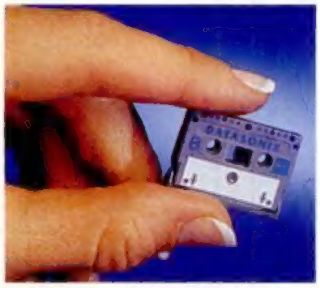

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The TOP 100 CD-ROMS

BY LANCE ULANOFF For the second year in a row, we bring you the Top 100 CD-ROMs. And there's no shortage of superb titles in this evaluation. Most of the CDs, in fact, do an excellent job of mixing fun and facts with great animations, audio, and video. Many of the multimedia technologies have clearly reached a new level of excellence. We've culled the winning CDs from hundreds of titles. Whether they're for the office, the reference shelf, the home, the kids' room, the rec room, or the coffee table, you'll find the best of the breed right here. We also include tips and information on market trends to help you keep on top of the ever-changing world of CD-ROM.....102

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Cover illustration by Jesse James Doquilo

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SERVICE WITH STYLE

BY PADRAIC R. BOYLE

Most of today's new file servers are designed from the ground up to maximize performance, expandability, security, and manageability. But there's still a gap between file servers best suited for the task and those that are merely adequate. For a properly equipped midsize network—one with 25 to 100 workstations—you need to know which servers can handle the load before you commit your critical data to them. We run 14 departmental servers through our demanding NetBench tests to find out which products deserve a spot in your server closet **167**

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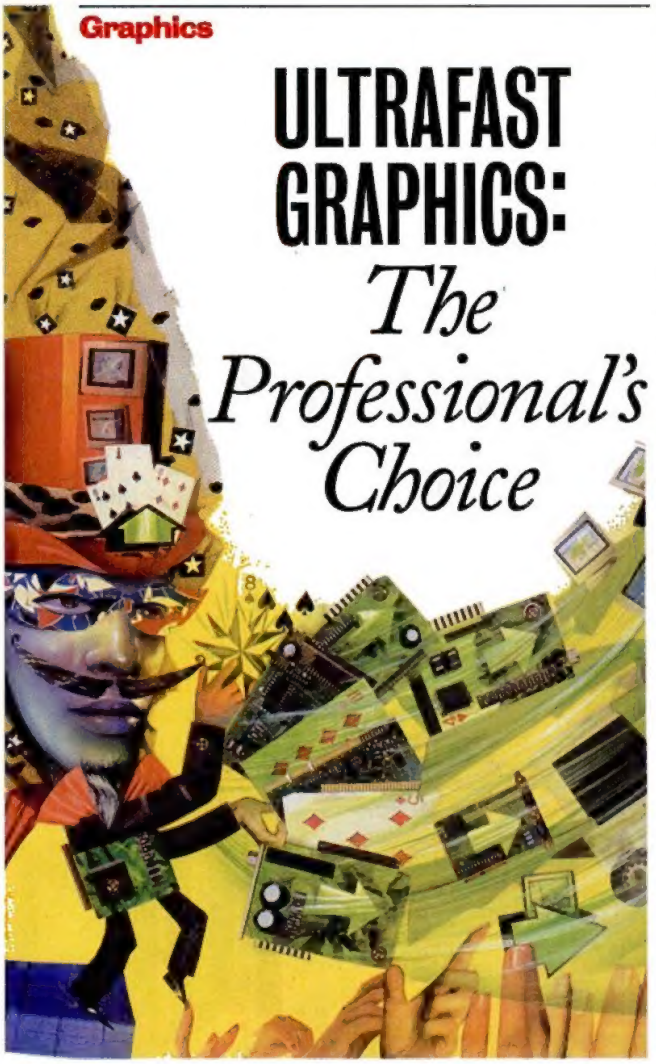
ULTRAFAST GRAPHICS: *The Professional's Choice*



BY JEFF MACE

Graphic designers, color production specialists, and CAD/CAM engineers rely on their adapters for lightning-fast video acceleration, superb color fidelity, and ultrahigh refresh rates at the highest resolutions. We look at 16 high-end PCI cards that deliver the resolution and speed you need **205**

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IT CAN SCAN A PICTURE

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I have this vision of Monument Valley in my head. You see, I've never actually been to Monument Valley. I've read about it in books and magazine articles. I've seen it in the television commercials for pick-up trucks and in the movies; you know, the exciting, old westerns. The buttes and the mesas, it's funny how those words rarely come up in conversation, but I'm sure if you were face to face with a massive, towering butte, it would stop you in your waffle-footed tracks. That's what I like about nature — its ability to remind us all that we humans are merely short-term inhabitants of our mighty Mother Earth. It's the magnificent red-hued rocks that leap up towards the breathtaking

OR A THOUSAND WORDS.

of concrete and steel, man-made monoliths that fool us into believing that we too can create in a moment what the gods of this arid world have taken forever to construct. There is a seventeen mile drive that winds through the ragged heart of Monument Valley. I've read that the drive provides visitors with sweeping views of the valley from different vantage points. I suppose, if you were in a hurry, this would be the way to see this place. But it's not the method I would use (why would you come here if you were in a hurry?). I'd get on a strong horse and ride wherever I wanted to go. I'd ride right up to the big rocks and stare straight up to the sheltering sky. I believe a place like this

absolutely nothing from us. It is a self-sufficient kingdom of layered sediment, simultaneously eternal and impermanent. Nothing we say or write about Monument Valley makes it more or less powerful. Yet we are moved to react to its noble beauty. And in reacting, we praise the purity — there's that word again — of this place. And in appreciating Monument Valley, we learn to appreciate what is good and important in our lives. The immutable laws of nature remind us to stop and smell the flowers, to cherish our children, to revere our parents and grandparents, to love one-another as we love the majesty of these monuments. This place is a magical looking-glass through which we may see the true character of our souls. I have this vision of Monument Valley in my head. And when I see this vision, I feel closer to a world that embraces me; a world that invites me to share in the sovereign beauty of rocks that rise towards the heavens and dunes that run forever. They remind me that, no matter where I go and what I do, I will always feel these monuments in my heart. I will always hear the chattering wind in my head. I will always see the extraordinary silhouettes of the ages. And I will always find a reason to keep going forward. I have this vision of Monument Valley in my head...

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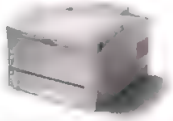

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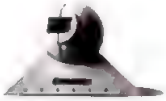

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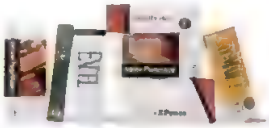

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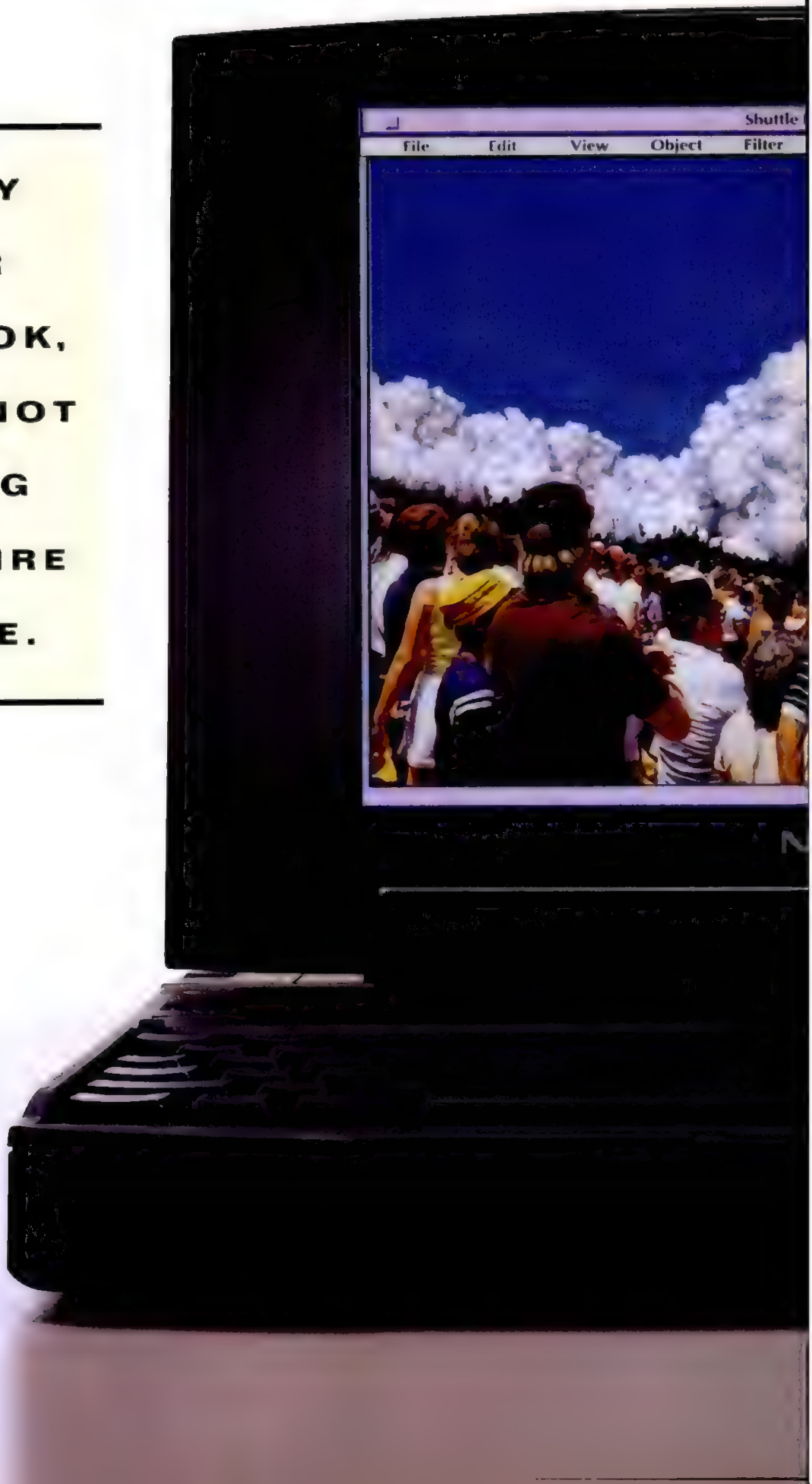

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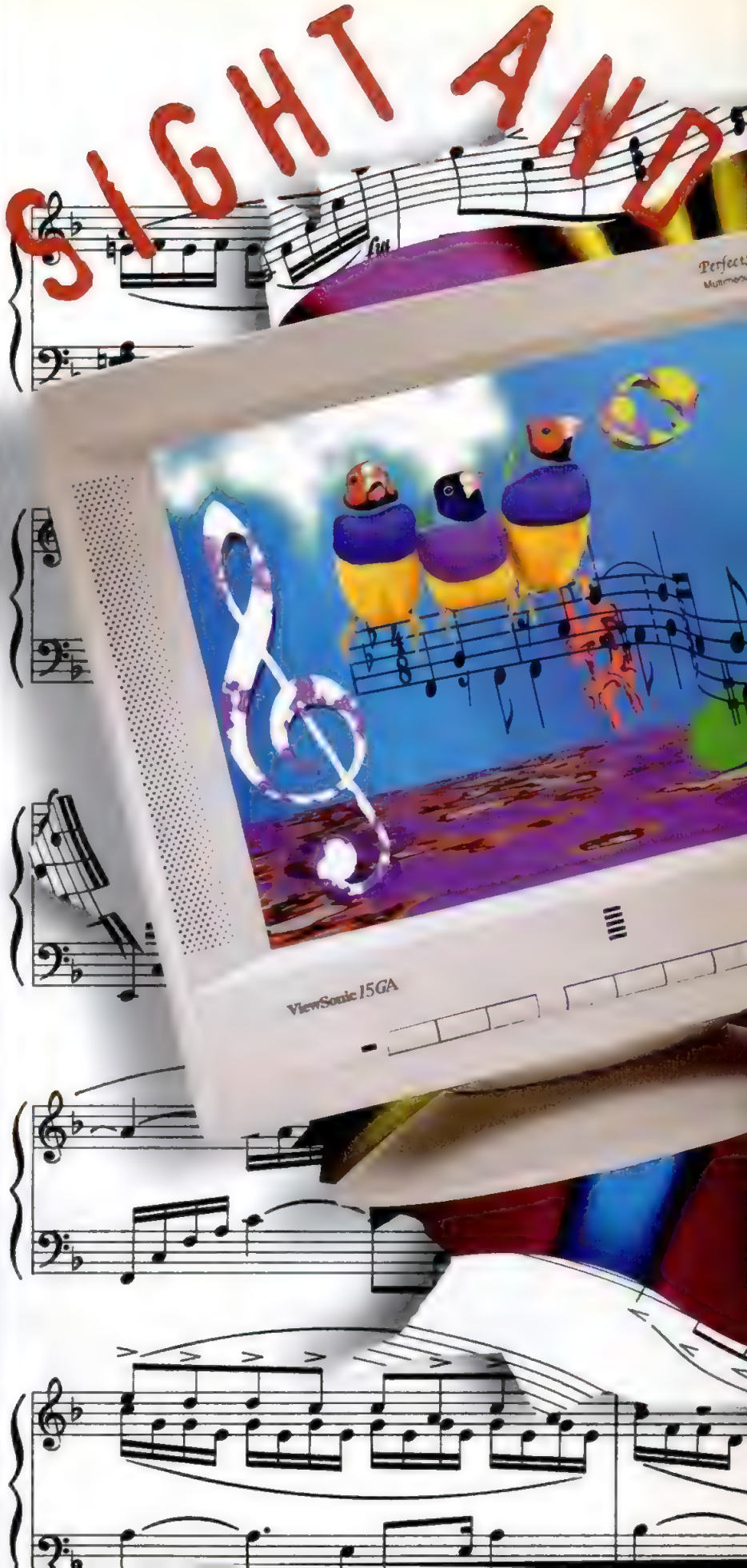

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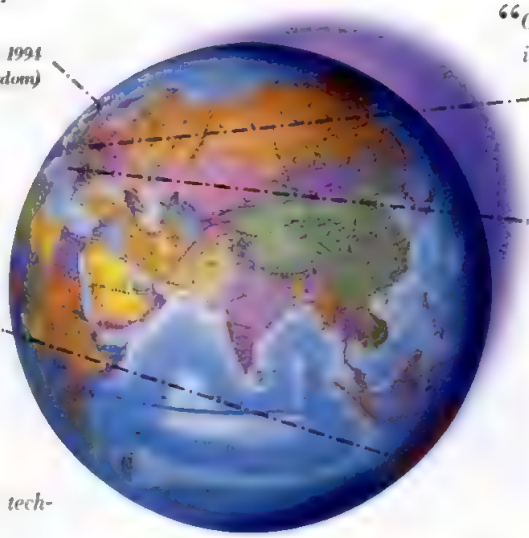
Looks like the whole world is getting Warped.

"*OS/2® Warp is faster and prettier than ever before. It's reliable, and can give you 32-bit computing on your desktop today.*"

Personal Computer World, *December 1994* *(United Kingdom)*

"*OS/2 Warp...brings advantages which give it a significant technical lead...*"

The European, *October 14, 1994* *(Europe)*



"*[OS/2] Warp is the natural upgrade for OS/2 for Windows™ users as it will run the latest versions of Microsoft®'s Windows software.*"

The Courier Mail, *October 18, 1994* *(Australia)*

"*Fast, dependable, able to work better with fewer resources...a viable candidate for standard operating software for the multiplatform PCs of the future.*"

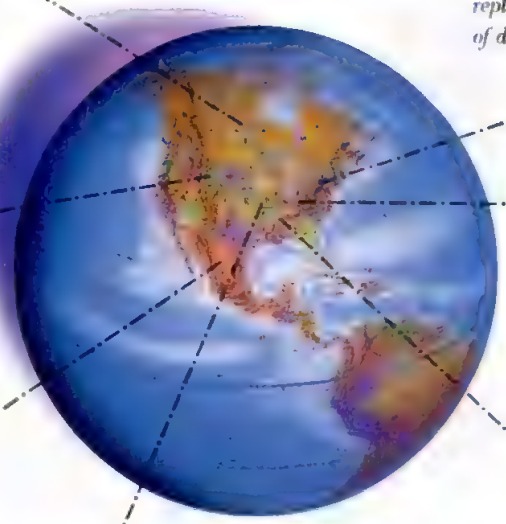
PC Windows, *September 1994* *(Italy)*

"*With Windows 95 delayed...this is IBM's window of opportunity. OS/2 has always been technologically superior...*"

Kevin Linfield, Computing Now! *December 1994* *(Canada)*

"*IBM's OS/2 has quietly evolved from a DOS replacement to a corporate-class, scalable family of desktop and server solutions.*"

PC Week, *November 14, 1994* *(USA)*



"*...no operating system product to date has offered as much out-of-the-box value as OS/2 Warp.*"

InfoWorld, *November 14, 1994* *(USA)*

"*...it's obvious that IBM® has put a great deal of time and effort into making [OS/2] Warp a highly-optimized, easy-to-install, and easy-to-use operating system...*"

Stan Miastkowski, BYTE Magazine, *November 1994* *(USA)*

"*The wizard of OS/2...the main feature of this new version is that it requires less memory and it provides better performance.*"

InfoCHANNEL, *October 1994* *(Mexico)*

"*My personal favorite–perhaps the most useful productivity software available today–is IBM's superior operating system, OS/2.*"

FORTUNE, *March 6, 1995* *(USA)*

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Letters

WARP VS. WINDOWS DEBATE RAGES ON

John C. Dvorak's column "To Warp or Not to Warp" (March 14, 1995) added fuel to the ongoing debate over the competing operating systems OS/2 Warp and Microsoft Windows.

Finally, a story that discusses OS/2 Warp's strengths and not just its weaknesses. Dvorak should be commended on his fair look at Warp.
WAYNE WU, *via the Internet*

Contrary to Dvorak's statements, I've found that DOOM runs fine under OS/2 Warp, provided the sound is generated under DOOM's setup program through the PC speaker and not through the sound card. Postings on Usenet indicate that different versions of DOOM work to different extents; Dvorak gave the impression that DOOM doesn't work at all, which is inaccurate.
JOHN J. O'NEILL, *via the Internet*

The only problem I have using DOOM under Warp is getting my children to quit playing long enough so I can use my PC.
G. POWELL, *via the Internet*

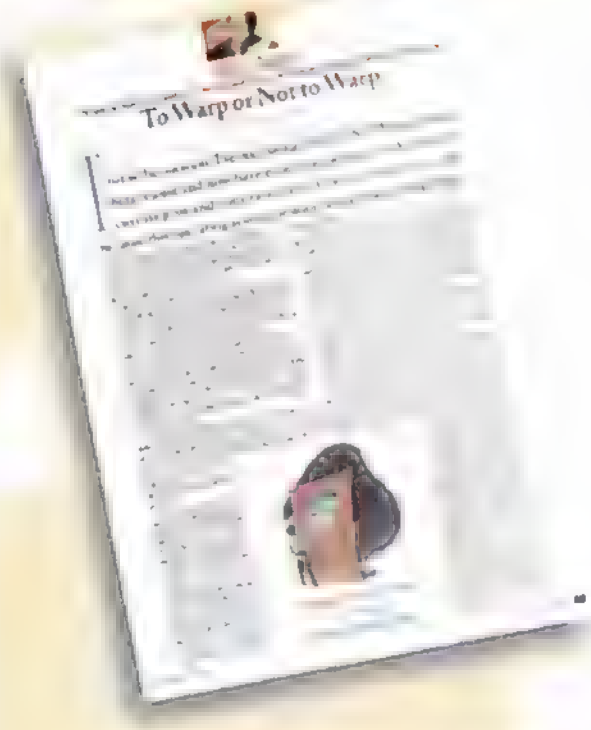
It was nice not to see the usual "It'll do until Windows 95 comes out" tucked into Dvorak's column. And by the way, a native OS/2 version of DOOM is due soon.
C. MICHAEL WHITNEY, *via the Internet*

Windows attempts to be a jack-of-all-trades, but unfortunately it ends up a master of none. The real success of OS/2 is its flexibility in bringing many elements together.
DAVEY S. THORNTON, *via PC MagNet*

Although I can see that Warp has potential, I had too many problems trying to find drivers for my video card. It was also frustrating how long it took to load Warp; I felt as if I were back in 1978 waiting for my TRS-80 Model 1 to load software from a cassette tape.
MICHAEL BRYAN, *via PC MagNet*

I couldn't agree with Dvorak more. Installation of OS/2 Warp is not for the faint of heart. Documentation is good but not great. And the way it handles device drivers for popular brands is enough to take a couple of years off anyone's life. The good news is that once OS/2 Warp is up and running, Windows and DOS pale in comparison.There's an elegance to OS/2 that can't be beat.
TOM DEFELICE, *via the Internet*

Getting Warp installed does require a small miracle. I didn't have problems with my video card, but it was the only component I didn't need to get a new driver for. Only after much wailing and gnashing of teeth—and some



Windows attempts to be a jack-of-all-trades but is a master of none.

swearing—did I get Warp to work. IBM needs to make the installation process easier and more user-friendly.
ADAM G. BOWEN, *via the Internet*

When I saw the title, intro, and highlighted quote, I assumed that Dvorak had had some installation difficulties and dismissed OS/2 as a viable option. Imagine my pleasant surprise to read that Dvorak had actually used it long enough to get his system properly configured and discover the strengths of OS/2. It takes time to learn a new operating system. I converted from Windows and haven't looked back.
B.B. BEAN, *via the Internet*

Getting Warp running right draws deeply on one's stores of emotional stability. Dvorak's column hit precisely the right tone.
BRADFORD C. ROBERTS, *via PC MagNet*

Dvorak is right about Warp's prompting an emotional response. In my case, it has prompted feelings of frustration and anger. For now, I'm happily using Windows and eagerly awaiting the arrival of Windows 95.
SAKARI SARO, *via the Internet*

OS/2 Warp is indeed warped; I had major problems installing the program on my PC. For now, I'll stay with DOS 6.22 and Windows 3.1 and await Windows 95's arrival.
BOB BURNS, *Fresno, CA*

My experience with Warp was just the opposite of Dvorak's. I spent two days installing Warp and six days trying to get everything to work right; I had to reboot my machine at least three times a day after Warp crashed. I'm now using the Windows 95 beta, and I've had less problems with that than with Warp.
RUSSELL GRIGAT, *Edmonton, Canada*

Although I loathe Windows, I use it because there are good applications available. When I switched to Warp, I had many installation difficulties that were unbelievably frustrating, and a few times I almost chucked the whole thing. But once the program finally did install, it worked so wonderfully that now I've grown to love it. Warp gives you the best of everything at a low cost.
LAURA BATMAN, *via the Internet*

GO TO THE HEAD OF THE CLASS

Thank you, Bill Howard, for a column that remembers those of us who still have a desire to think for ourselves ("The Tyranny of the Minority," March 14, 1995). In an age when personal responsibility is almost nonexistent, at least *PC Magazine* realizes that some of us don't mind having to learn something new or complicated to achieve the maximum benefit from our computers. With the proliferation of front ends arriving to simplify the computer interface, it's comforting to know that power users still have a voice in your pages.
STEVEN C. MATHIAS, *via PC MagNet*

One of the joys of using different software is seeing the vast imagination of programmers at work. I hope no one takes Howard up on his recommendation to limit boxes for mini-applets to three sizes. Uniformity in design is terribly restrictive, to say nothing of boring.
FAROKH MONAJEM, *via PC MagNet*

Right on the mark! I really enjoyed Howard's column. I'm sick of things like Microsoft Bob and all these other numb-nuts ideas to make Windows more friendly to newcomers. Who's looking out for us power users and our needs? Howard's ideas for Windows improvements were all on target. Instead of designing software for "somebody else," developers should design software they'd want to use themselves.
WADE H. NELSON, *via the Internet*

Three cheers for Howard. I love what Windows allows one to do, but I hate the hassle of the "training wheels" interface: too many clicks, too many microscopic list boxes, and too many confirmation boxes.
FRANK BILLINGTON, *via PC MagNet*

Howard's question "Who's watching out for the skilled users?" raises an interesting point about technical support. It's practically impossible to find tech support that does not insult our intelligence. How many of us have been forced to listen politely to a two-week

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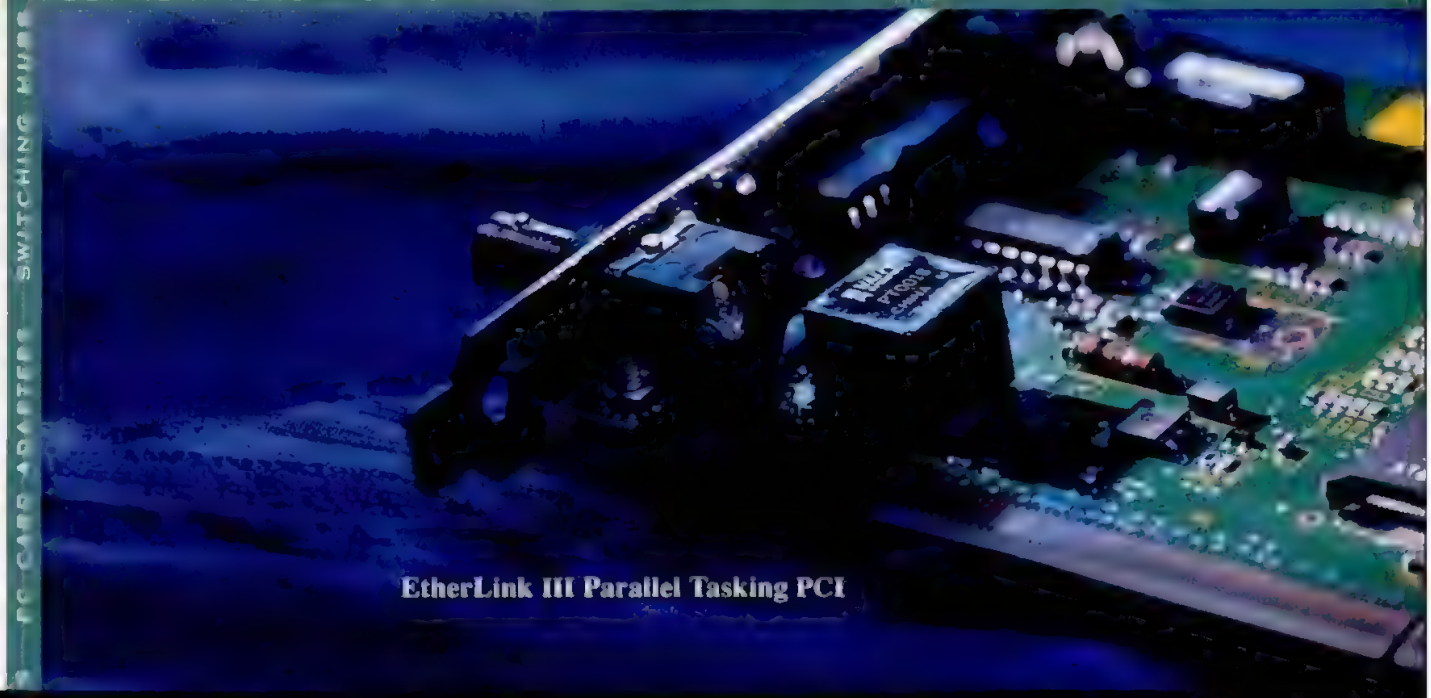

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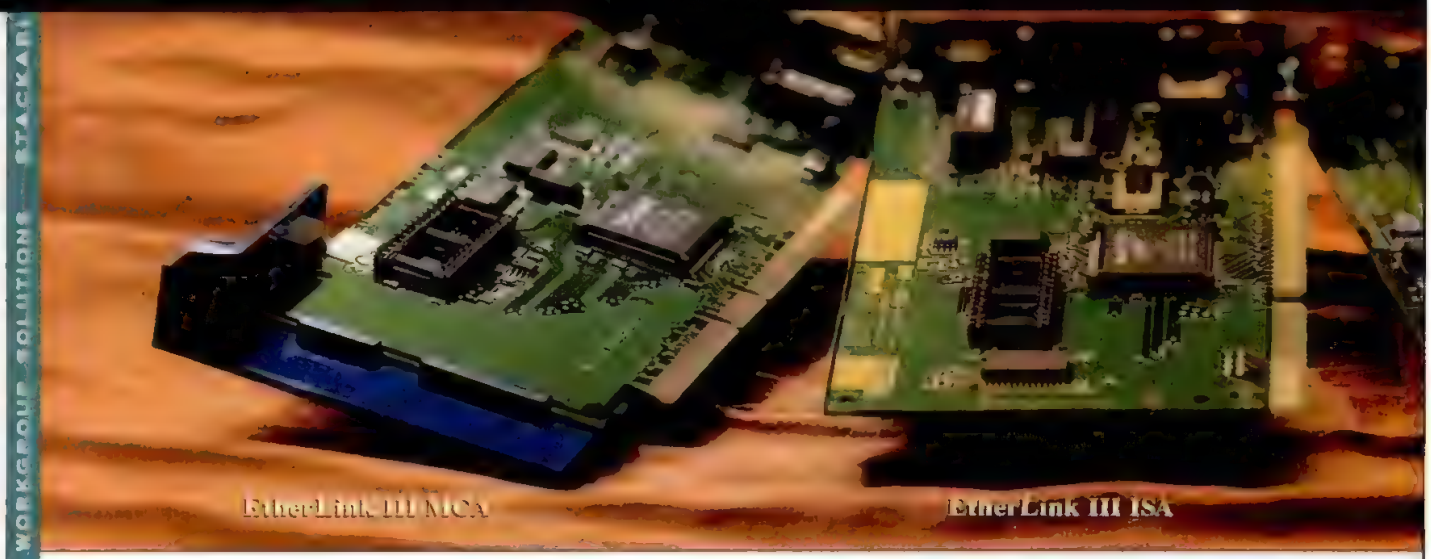

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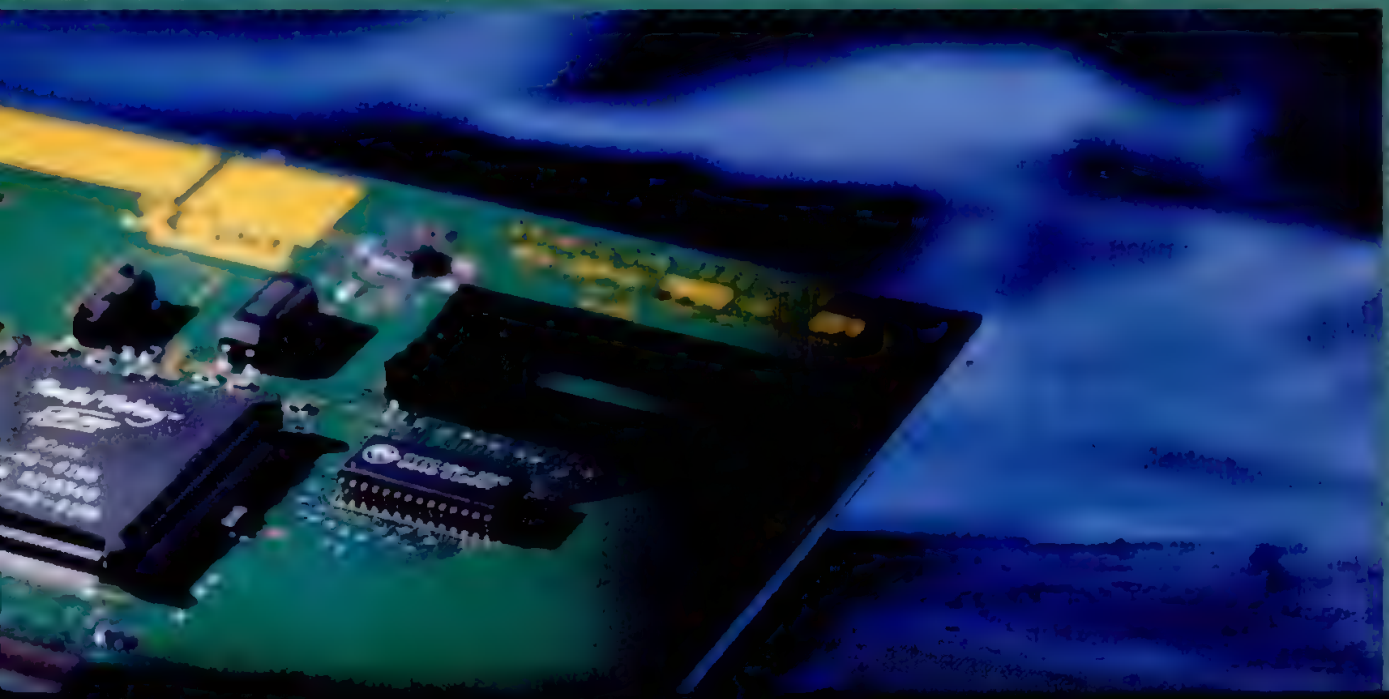

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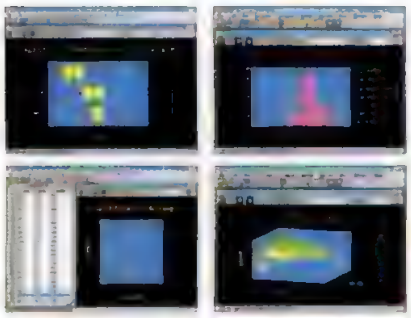

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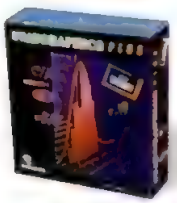

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Letters

veteran of tech support ramble on about how we should strip our startup files down to nothing but a PATH statement to remedy what is plainly a defect in a piece of software?

DOUG KANTER, *via PC MagNet*

OF TALKING DOGS AND SMILEY FACES

The real threat to the American way of life is Microsoft's new "social interface," Bob, which is discussed in Robin Raskin's Pipeline column "The Trouble With Bob" and Bill Machrone's column "Great Product, Terrible Name" (March 14, 1995). Just imagine millions of home users repeating "Hi, Bob" again and again in vain to elicit a response from the eponymous smiley face in Bob, the only mute member of a cast of yakkety characters.

RON FEIGENBLATT, *via the Internet*

I've yet to hear anyone say anything good about Bob. In spite of Microsoft's cheery smiley face, my image of Bob is that of the evil spirit that inhabited the north woods in the TV show "Twin Peaks."

GARY BRUNNER, *via PC MagNet*

After reading about Bob and knowing Microsoft's litigious nature, will my friend Robert (we call him Bob) now have to start paying a licensing fee if he wishes to continue using that name?

KEVIN SPATZ, *via PC MagNet*

Perhaps Microsoft should consider regional family information managers. Why, here in the deep South we could have something neat like "Bubba." The initial screen might even have a regional representation like two cousins courtin' in the front seat of a pickup. Wow, think of the possibilities.

BOB SMITH, *Gulfport, Mississippi*

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CORRECTIONS AND AMPLIFICATIONS

In the sidebar "The Video Editor's Toolkit" ("Digital Video: Shot by Shot," April 11, 1995), the correct phone numbers for Fractal Design Corp. are 800-297-2665 and 408-688-8800.

In our review of InterGroup Technologies' VisualWare, Version 2.3, Corporate Edition (Toolkits, "Enchance Apps With VBA Clone," April 11, 1995), we mistakenly indicated that that it supports and includes Summit Software's BasicScript.

In "Tapping the Promise of the Pentium," May 30, 1995, the review of Sys Technology's Sys Performance P100T incorrectly stated the amount of video RAM and type of cache used in the tested system. The machine contained 2MB of VRAM and used pipelined-synchronous-burst cache.

CRAFTING VIRTUAL REALITIES

Your round-up of virtual-reality software ("Virtual-Reality Software World Builders," March 14, 1995) was very informative. Hopefully, it will have excited readers to consider creating virtual worlds.

RANDALL OELERICH, *via the Internet*

WINDOWS GETS A FACE-LIFT

As a magazine aimed primarily at the business market, I can't believe you suggest that your readers spend $457.85—the list prices of your Editors' Choices—on Windows' Band-Aids ("Why Wait? Get More From Windows Now!" March 14, 1995). Especially when considering that for $129 you can purchase OS/2, which "delivers a generous share of the bells and whistles offered by the Windows utilities in this review," as you note in your sidebar "OS/2 Warp: A True Alternative."

ALBERT DAVIS, *via the Internet*

Your review of utilities has one glaring omission: With which version of Windows does the utility work effectively? It's a key point, considering the various Windows versions available.

BILL SNYDER, *via the Internet*

I enjoyed your round-up of Windows utilities very much. I've already tried just about every utility available on ZiffNet; they're quite useful, so please keep them coming!

JOSEPH J. MONFORTE, *via PC MagNet*

Thanks for including the sidebar on compression-utility shareware. I've found shareware to be a good source of small, special-purpose programs and am glad to help out the proverbial guy in the garage. I hope that you'll continue integrating shareware products into reviews. Both developers and consumers will benefit.

DAVID M. DUMA, *via PC MagNet*

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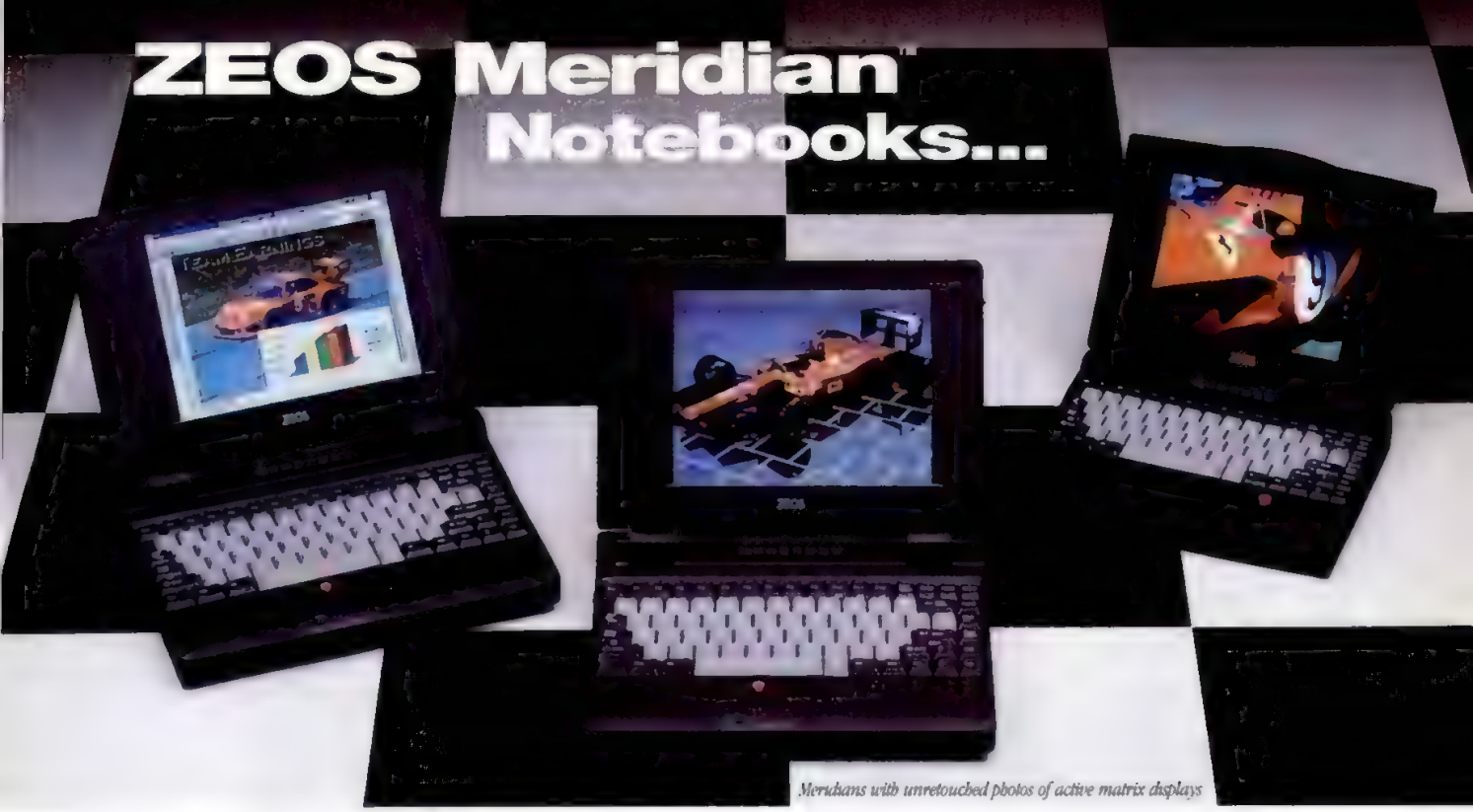

Meridians with unretouched photos of active matrix displays

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And they just got faster! Added to our already speedy Meridian line is the ZEOS Meridian 850 notebook featuring a Pentium-75 processor.

While each Meridian product is distinct, they all have several hot features that add to their impressive speed and ease of use including local bus video; a comfortable palm rest with an integrated TruePoint pointing device; and an 84-key keyboard.

Meridian 400 Subnotebook

WINDOWS 1995 WIN 100 May 1995

"ZEOS is out to prove that good things do come in small packages with its Meridian 400C subnotebook," reported *Windows Magazine*.

At 3.9 pounds, the Meridian 400 subnotebook is molded from a special carbon-fiber material that cuts weight and improves durability. And with your choice of a 486DX2-50 or DX4-100 processor, hard drives to 350MB, and RAM that's user upgradable to 20MB, this notebook is "faster than a speeding desktop," as *Computer Shopper* said.

The 400 features active and dual-scan color screen options. You also get two Type II PCMCIA slots and an external ultra-light 3.5" 1.44MB floppy drive (included in Packages 2 and 3).

Meridian 800 Notebook

WINDOWS 1995 WIN 100 May 1995

"The 800C notebook offers sleek styling, solid construction and hot performance.... one of the fastest notebooks we've ever tested," said *Windows Magazine*.

At 6.3 pounds, the Meridian 800 full-size notebook is light enough to travel anywhere yet it's large enough to use for presentations and everyday computing. And with your choice of a 486DX2-50 or DX4-100 processor, removable hard drives to 528MB, and RAM that's user upgradable to 20MB, this notebook is the raciest thing around.

For your viewing pleasure, the 800 is available with your choice of color displays—a whopping 10.3" dual scan or 9.5" active. You also get two Type II or one Type III PCMCIA slots, and an internal 3.5" 1.44MB floppy drive.

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a mammoth 10.3" (800 x 600) dual scan or 9.5" active matrix. You also get 16-bit stereo sound through audio jacks (Sound Blaster Pro compatible) for the best in portable multimedia, two Type II or one Type III PCMCIA slots, and an internal 3.5" 1.44MB floppy drive.

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486 & DX4

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Dual Color	**400C**	**800C**	**Dual Color**	**400C**	**800C**	**Dual Color**	**400C**	**800C**
486DX2-50	**$1995**	**$2195**	**486DX2-50**	**$2295**	**$2395**	**486DX2-50**	CN! **$2595**	CN! **$2695**
DX4-100	**$2395**	**$2595**	**DX4-100**	**$2695**	**$2795**	**DX4-100**	CN! **$2995**	CN! **$3095**
Active Color	**400A**	**800A**	**Active Color**	**400A**	**800A**	**Active Color**	**400A**	**800A**
486DX2-50	**$2695**	**$2995**	**486DX2-50**	CN! **$2995**	**$3195**	**486DX2-50**	CN! **$3295**	CN! **$3495**
DX4-100	**$3095**	**$3395**	**DX4-100**	CN! **$3395**	CN! **$3595**	**DX4-100**	CN! **$3695**	CN! **$3895**
➤ 4MB RAM ➤ 260MB IDE hard drive ➤ 800: Internal 3.5" 1.44MB floppy drive ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **MS Works**			➤ 8MB RAM ➤ 350MB IDE hard drive ➤ 3.5" 1.44MB floppy drive. 400: External, 800: Internal ➤ Custom nylon carrying case ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **MS Works**			➤ 8MB RAM ➤ 350MB IDE hard drive (400), 528MB IDE hard drive (800) ➤ 3.5" 1.44MB floppy drive. 400: External, 800: Internal ➤ **14.4 PCMCIA fax/modem** ➤ Custom carrying case. 400: Leather, 800: Nylon ➤ Extra battery ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **MS Works**		

Pentium

Package 1		Package 2		Package 3	
Dual Color	**850C**	**Dual Color**	**850C**	**Dual Color**	**850C**
Pentium-75	**$3295**	**Pentium-75**	CN! **$3795**	**Pentium-75**	**$4195**
Active Color	**850A**	**Active Color**	**850A**	**Active Color**	**850A**
Pentium-75	**$4095**	**Pentium-75**	CN! **$4595**	**Pentium-75**	**$4995**
➤ 8MB RAM, 256K synchronous SRAM cache ➤ 528MB IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **MS Works**		➤ 16MB RAM, 256K synchronous SRAM cache ➤ 528MB IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ Custom nylon carrying case ➤ Extra battery ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **MS Office Pro**		➤ 16MB RAM, 256K synchronous SRAM cache ➤ **810MB** IDE hard drive ➤ Internal 3.5" 1.44MB floppy drive ➤ Integrated 16-bit stereo sound ➤ **14.4 PCMCIA fax/modem** ➤ Custom nylon carrying case ➤ Extra battery ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **MS Office Pro**	

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  - ➤ RAM expandable to 20MB (850 to 32MB).
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- ➤ PCMCIA slots. 400: 2 Type II, 800 & 850: 2 Type II or 1 Type III.
- ➤ Display: Color VGA backlit LCD, up to 256 colors. 400: 640 x 480 7.9" DSTN or active matrix. 800: 640 x 480 10.3" DSTN or 9.5" active matrix. 850: 10.3" **800 x 600** DSTN or 9.5" 640 x 480 active matrix.
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CIRCLE 254 ON READER SERVICE CARD

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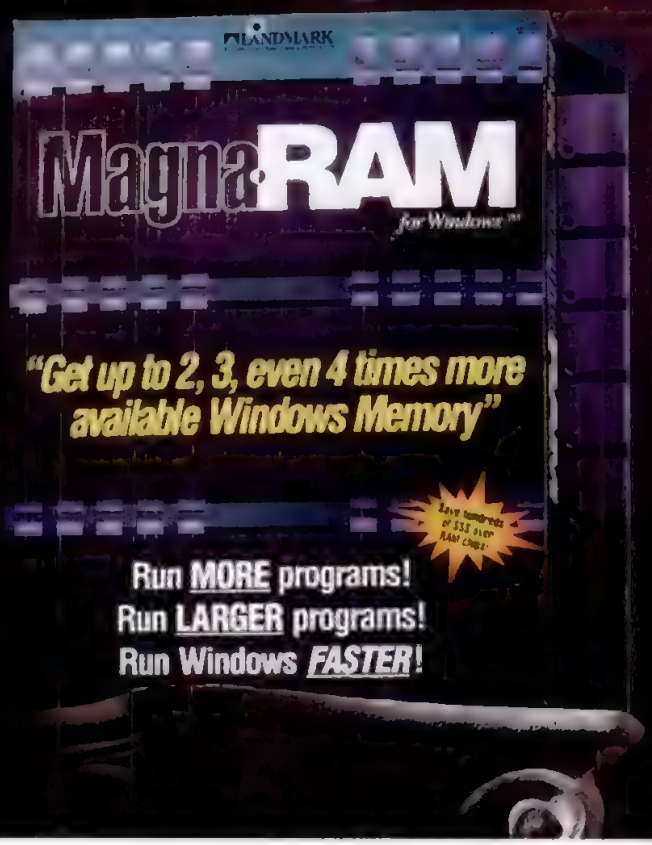

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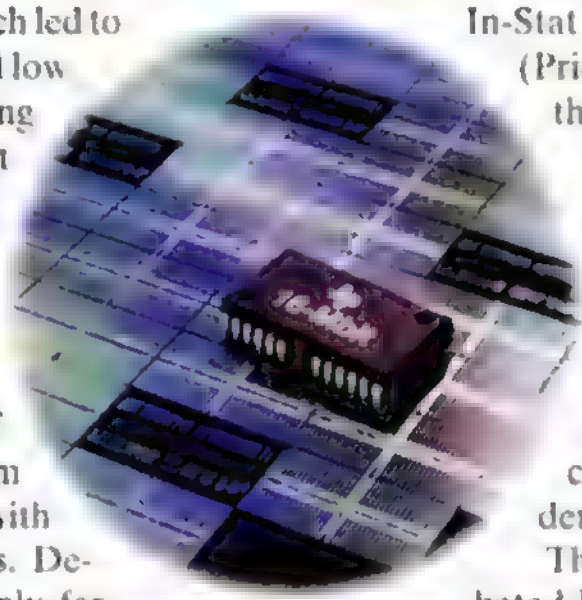
CIRCLE 069 ON READER SERVICE CARD

DRAM Dynamics

Memory shortage spurs global alliances.

Trying to break out of the boom/bust cycles of the past, the memory-chip industry is investing more cautiously in future technologies and forming transcontinental partnerships to share the soaring cost of manufacturing. Nevertheless, the industry seems unable to shake the chronic memory-chip shortage.

The shortage was set in motion in the late 1980s when manufacturers overinvested in new fabrication plants, which led to an oversupply of chips and low prices. To avoid getting burned again, companies cut investment in new fabs. Then, just when investment dried up, the latest PC boom hit—fueled by soaring sales of PCs into homes, the debut of memory-hungry Pentium systems, and applications with big memory requirements. Demand for memory suddenly far outpaced supply.



Memory chip makers are gearing up to meet demand.

"Right now, demand is 20 percent higher than supply," says Farhad Tabrizi, senior strategic marketing manager at Hyundai Electronics America Corp. Tabrizi sees the shortage continuing through 1996, and is coping by adding capacity. A plant now under construction in Ichon, Korea, is designed to produce 25,000 wafers a month.

The memory business doesn't always play by the traditional rules of supply and demand. While commodity markets usually correct for shortages, the DRAM market works differently because large PC and board manufacturers purchase supplies on one- and two-year contracts. During a shortage, price increases are not always passed on to computer buyers. "Due to the huge demand in 1994, however, you did see price increases," says Jim McGregor, senior analyst of DRAM memory at research firm In-Stat in Scottsdale, Arizona. (Prices on the spot market, on the other hand, are volatile.)

Also, during a shortage, system manufacturers ship PCs with less memory than customers want. So instead of buying a PC with the 8MB you want, you get 4MB. This short-changing creates pent-up demand for upgrades.

The shortage is also exacerbated by moving manufacturing lines from 4Mb to 16Mb chips. The transition to smaller-size, higher-density components, to 8-inch silicon wafers, and to wider-architecture chips has proven to be more difficult than expected. "Because of the lack of investment and fab capacity, some of the newer, higher densities were pushed out," says McGregor.

The latest trend is for companies to forge global alliances to acquire additional manufacturing capabilities and to offset the costs of designing and manufacturing higher-density devices. And with the price of a new fab approaching $1.5 billion, splitting the cost is essential. "DRAM manufacturers have gotten a lot smarter about how much capacity to add," says Walt Lange, manager of the memory-business office at IBM Microelectronics, which is investing in the 64Mb market in alliance with Siemens.

The decline of the dollar against the yen is also changing the dynamics of the memory market. While the price of goods imported from Japan rises, the price of goods from Korea and Taiwan don't fluctuate widely since their currencies are pegged to the dollar. "The Koreans are leading the way and Japan is playing catch-up. You're going to see Korean and Taiwanese companies cranking out parts over the next year," says McGregor.

Meanwhile, the Japanese are investing in new fabs in the U.S. through joint ventures. And Korean companies such as Samsung are also looking to build new fabs in the U.S. Some of the alliances include Acer and Texas Instruments; Fujitsu and Hyundai; Hitachi and LG Semicon; IBM and Philips; IBM, Seimens, and Toshiba; LG Semicon and Motorola; Mitsubishi and Motorola; Motorola and Toshiba; NEC and Samsung; and Texas Instruments and Kobe Steel.

The impact of the new DRAM fabs is expected to hit the market in 1996 and 1997. Some industry observers predict a memory glut. In the short term, though, the memory shortage may be in full swing once Windows 95 ships. Microsoft recommends running the operating system with 8MB of RAM.

—Carol Levin and Melissa Perenson

The Memory Market's Wild Ride

While demand for memory should continue climbing through the 1990s, additional supply should help hold prices to normal increases. Increases of 15 percent indicate higher-than-expected demand or significant changes in exchange rates, or both.

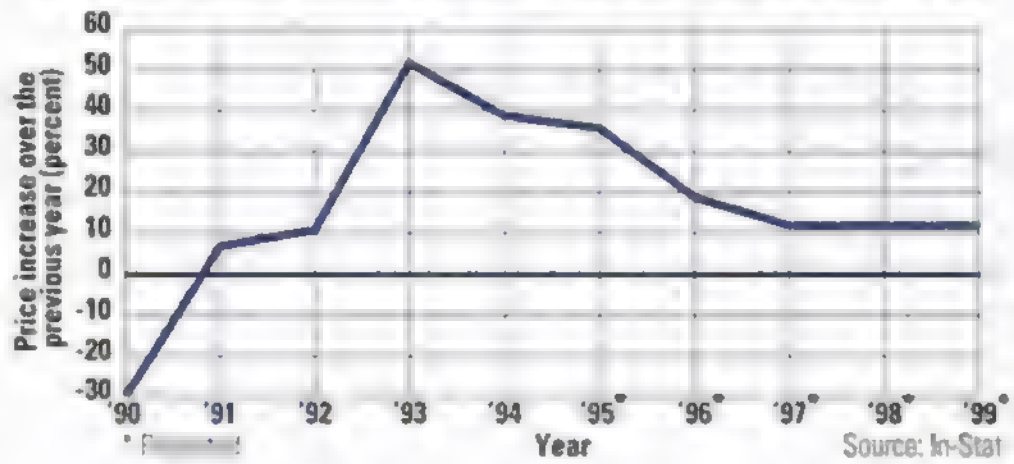


Photo courtesy of Texas Instruments

Pipeline *By Robin Raskin*

Doomed Again

In the 1980's, computers were capable of drawing a few circles and squares on a screen. But some saw the bigger game. Spacewar (which required a PDP-1 computer) begat Pong. Pong begat Breakout. Breakout begat PacMan, and so on.

This is the year of the 3-D maze, begat by DOOM. While the emotional caliber of those early games hasn't advanced much, the technology certainly has. Fluid movement and 3-D realism were the catalysts for DOOM's success. Now there are games like Rise of the Triad, which gives you 3-D first-person action with six degrees of freedom of movement. Play it with the $179 Spaceball Avenger, and there's no more bumping into walls. You'll fly over or duck under them.

For the first time, these mazes go beyond games. Knowledge Adventure's Random House Kids' Encyclopedia contains a fast-action maze based on an encyclopedic scavenger hunt. Absolut Vodka's disk sends you through a maze of best-loved ads. On-line art galleries, travel brochures, playgrounds, and even collections of data can be visited using maze-like interfaces. Check out *http://www.pathfinder.com* for a tour through a maze-like virtual garden. Watch for virtual worlds and the tools to build them from companies such as HSC Software (makers of Kai's Power Tools), Visual Software (creators of 3-D clip art), and even Novell, with its Corsair and Ferret projects. Participate in multiplayer games with "personas" (available from MPG-Net at 800-438-4263), where you wander around as an avatar and bump into other virtual folks in the maze.

Now Microsoft wants in on the maze. New Windows 95 application programming interfaces (APIs), low-cost hardware graphics acceleration, and on-line services will unite to render mazes that make DOOM look like easy street. (See Trends story).

Microsoft has cobbled together a set of game APIs, available as a software development kit (they're too unproven to ship as part of the operating system), that are designed to provide direct access to video- and sound-card memory. Microsoft has finessed technology from OpenGL on Windows NT and combined it with some technology from graphics boards vendors to create an SDK that promises a rich, fluid, 3-D-sound game platform. (My best guess is that it will offer sprite animation from ATI, 3-D from Matrox, and sound/graphics features from Diamond.) The DirectPlayAPI speeds up remote data transmission, and the Direct Input API supports a new generation of peripherals.

There are three Microsoft agenda items at work here. First, 30 percent of PCs are sold for the home, where DOS games are still king. Microsoft needs to play DOS games better than DOS plays them. Second is to beat Sega and Nintendo at their own games. Both game makers promise a new generation of 64-bit play machines in time for this holiday season. The third—and the most covert—is to create a rich platform for on-line multiplayer games. So the next move you enter might be played remotely.

Robin Raskin is the editor of PC Magazine.

Infrared Everywhere

SURE, TODAY YOU CAN SEND A letter via infrared from your notebook to a printer, but what about using an infrared credit card to pay for your double skinny latte at the cappuccino machine?

That's just one direction in which infrared is heading. At the Windows Hardware Conference and at Spring Comdex, Microsoft CEO Bill Gates described this futuristic credit card, as well as the future of ubiquitous infrared applications.

The Infrared Data Association (IRDA) plans to publish a new infrared standard in June that will address speed and range limitations. "Our standard was designed with a 115-Kbps limit, but we'll soon enable 1 Mbps to 4 Mbps," says IRDA chairman John Laroche. "At those speeds, new infrared applications such as Ethernet connections will be possible."

Mind Path Remote Control sends infrared...

Meanwhile, hardware devices of all kinds are incorporating infrared transceivers. IBM, Digital, Hewlett-Packard, and other notebook and printer manufacturers have adopted IRDA-standard transceivers. Extended Systems makes adapters for under $200 that can infrared-enable any printer or notebook. Hewlett-Packard and Microsoft have confirmed that Windows 95 will include a driver for infrared devices.

There's also growing interest in bringing infrared to the hardware-component level. Crystal Semiconductor's CS8130 Infrared Transceiver chip is targeted to be part of chip sets from several notebook manufacturers. Both Intel's Universal Serial Bus (USB) proposal and Apple's similar Geoport effort, which enable daisy-chaining of many devices from an all-purpose serial bus, could mean that serial-port infrared devices wouldn't hog the whole port.

The telephone, television, and cable industries are waking up to infrared technology, too. Mind Path Technologies, which makes infrared-enabled remote controls for PCs, is focusing on infrared-smart software controls to link PCs with televisions and consumer electronics.

Meanwhile, Nokia has just introduced an infrared adapter for sending cellular faxes over its mobile phones. AT&T, Japan's NTT, and Northern Telecom are working on infrared-enabled phone booths so your notebook or PDA can transmit wireless e-mail and fax. And Versit, the communications partnership among Apple, IBM, and Siemens, is currently working on a common wireless-data format so that business-card readers can exchange data via an infrared connection.—*Sebastian Rupley*

...signals to a receiver up to 45 feet to a receiver that is plugged into a serial port.

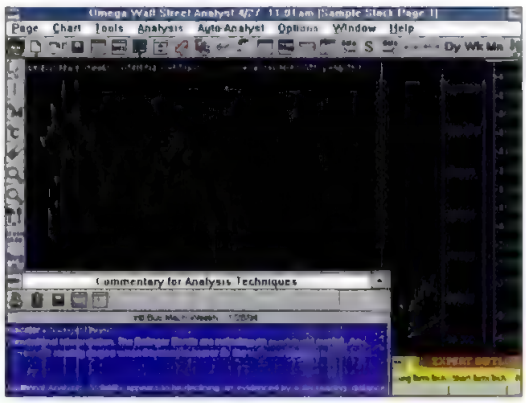
Smart Money

CAN A PC BEAT WARREN BUFFETT at picking stocks? From neural networks, which "learn" from thousands of historical stock market variables, to expert-system-based translation of arcane investment concepts such as stochastics, the PC is finally inheriting high-end investment savvy from the workstation world.

Go to Harvard Business School and claim that computers can beat the market, and you won't get a warm reception. The school's core curriculum teaches "efficient market theory," which argues that markets are beaten only by chance occurrences. Efficient market theorists point out that 80 percent of mutual-fund managers underperform market averages such as the S&P 500.

Computers may be the ultimate investors, though. Fidelity and Vanguard, the number-one and -two mutual-fund companies, offer three mutual funds with stock portfolios picked by computer workstations: Fidelity's Disciplined Equity, Fidelity's Stock Selector, and Vanguard's Quantitative Numeric fund. All three have beaten the stock market averages for years.

To pick the stocks for his Disciplined Equity and Stock Selector funds, Fidelity Investments' Brad Lewis, manager of the two Fidelity funds, uses a neural network and a polynomial algorithm model, a computer model designed to sort thousands of daily factor inputs and weightings for anomalous occurrences. Paul Tudor Jones, arguably the most successful living futures trader, gets many of his ideas from a desk of researchers running Omega Research's TradeStation software on PCs.



Wall Street Analyst's expert system goes to work on inscrutable investment concepts. Best of all, it speaks English.

Omega's TradeStation and its new Wall Street Analyst are unlike other technical-chart-analysis products in that they don't just plot prices against indicators. They also produce plain-English reports and provide a novice-friendly expert system.

Omega isn't alone in trying to demystify high-end investment concepts. Market Arts, makers of Windows On Wall Street technical-analysis software, has also developed an expert system to explain indicators such as relative strength.

"The institutional manager doesn't have a dramatic technology advantage anymore," says Ralph Cruz, Omega Research's vice president. Novices should watch their wallets, though. As world-class investment technology reaches the PC, it's worth noting that the market usually beats even world-class investors.

For a quarter-by-quarter and year-by-year look at the computer-driven market outperformance of Fidelity Investments' Brad Lewis, visit the company's new World-Wide Web site at *http://www.fid-inv.com.*
—Sebastian Rupley

Flash Update

FLASH STORAGE PROMISES TO change the way we store information. Offering near-instant access to data (a flash drive doesn't spin), low power requirements, resistance to shock, and portability, flash drives were expected to be inside everyone's desktop and notebook. So what happened?

While the predictions for the PC market were premature—due largely to the drop in prices of hard disk drives and the high price of low-capacity flash-memory cards—flash has been steadily working its way into answering machines, cellular phones, digital cameras, game cartridges, and vending machines. (Unlike traditional memory chips, flash chips don't require power to retain data.)

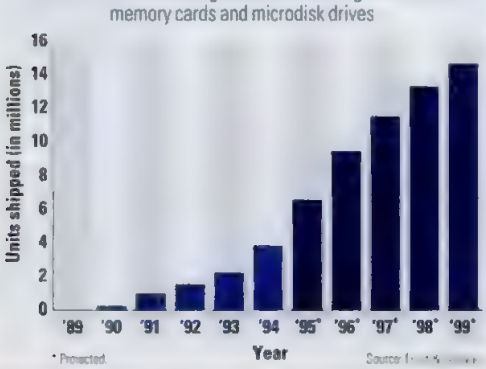
Today, flash-chip makers AMD, Intel, Samsung, Sundisk, and Toshiba are working on high-capacity chips, which are expected to bring down costs. SunDisk says that its 40MB cards now selling for $1,450 will retail for under $300 in 1997—still many times more than the per-megabyte price for a hard disk. By that time, its 500MB cards should be in production.

Other improvements promise to make flash cards more reliable, easier to use, and less expensive. The life of flash memory is no longer an issue. And since the reading and writing of data can now be controlled by software on a PC Card's controller chip, there's no need to load special drivers or mess with nonstandard flash-file systems.

A new controller chip, the CL-FC1120 from Cirrus Logic, emulates the PC Card/ATA industry-standard file protocol, so your notebook won't need a flash-card driver. Cirrus Logic has also developed a PC Card-based flash drive with on-board electronics that emulate a standard hard disk.
—Carol Levin

Flash Forecast

Demand for mobile storage devices is fueling sales of flash memory cards and microdisk drives



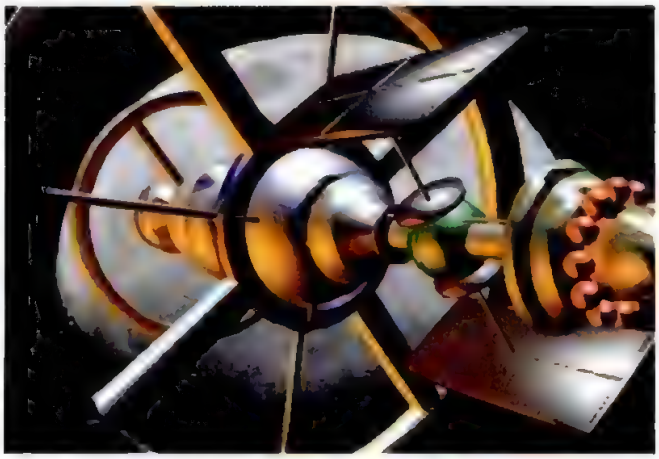
Top Retail Software

Current ranking	Last issue	Product/ company
1	—	**Remove-IT 1.0** *Vertisoft Systems*
2	5	**CorelGallery 1.0** *Corel Corp.*
3	4	**WinFax PRO 4.0** *Delrina Technology*
4	6	**QEMM 7.5** *Quaterdeck Corp.*
5	1	**Procomm Plus for Windows 2.1** *Datastorm*
6	9	**Internet In A Box** *SPRY*
7	2	**MS-DOS 6.22 Upgrade** *Microsoft Corp.*
8	10	**WinCheckIt 2.0** *Touchstone Software*
9	—	**MS Windows 3.11** *Microsoft Corp.*
10	—	**Uninstaller 2.0** *Microhelp*

This list ranks PC business programs according to the total number of copies shipped to over 12,000 stores and resellers in the week ending April 22, 1995; the list cannot be interpreted as a picture of the entire software market. Adapted from a compilation by Ingram Micro.

Game Junkies, Start Your Engines

GAMES ON THE PC ARE GOING through a minirenaissance. True 3-D graphics boards and software development tools are proliferating to enhance a new generation of souped-up games. By early next year, today's games will seem like pure retrograde.



Developers are just beginning to create games using Microsoft RenderMorphics Reality Lab, an engine for building 3-D objects.

Despite the popularity of Windows, most games on the store shelves still use DOS/VGA technology because graphics performance under Windows isn't fast enough. A year ago, Microsoft offered a bridge technology called WinG to address the shortcomings in the Windows Graphics Device Interface (GDI), but developers found that WinG was still too slow.

At the PC Gaming Conference in April, Microsoft announced its Games SDK (Software Development Kit), and released the first beta to games developers. An important component in the Games SDK is DirectDraw, which replaces WinG.

There are two parts to DirectDraw: an API layer that games developers can write to directly, and a hardware access layer (HAL) that communicates directly with the display hardware. The idea is to provide standardized access to advanced hardware features such as acceleration and 3-D processing.

Sitting side by side with DirectDraw and DirectDraw HAL are the Reality Lab 3-D interface, recently purchased by Microsoft from RenderMorphics, and the 3-D device driver interface (DDI), which Reality Lab uses to communicate with the display hardware. Microsoft is hard at work merging these two technologies into the final version of the Games SDK to be released this fall. GDI and the Games SDK will be integrated into the version of Windows that follows Windows 95.

DirectDraw lets games developers take advantage of high-performance graphics hardware features. Some of these features, such as support for double buffering, transparent BLTing (bit-block transfers), and context chaining, are available today in graphics cards such as the ATI Mach 64 series. But many of the 3-D animation capabilities are only just starting to appear on graphics cards now hitting the market.

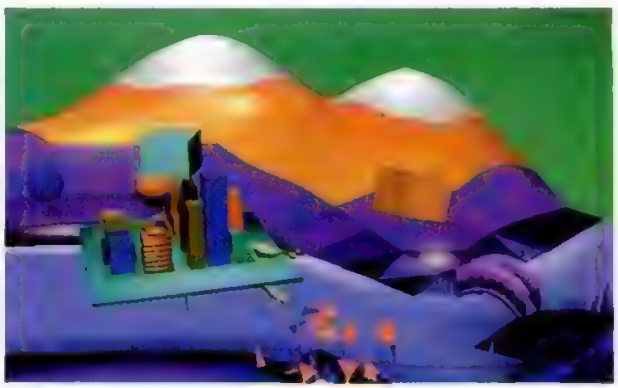
3-D animation requires a tremendous amount of processing. Objects must be described in terms of 3-D geometry, moved about in space, drawn in perspective (projecting the 3-D object onto a 2-D screen), and then rasterized (actually drawn on the screen). Most graphics cards currently available provide only the rasterization capability, and leave the other processing pieces to the computer's CPU. The complexity of animation in games is therefore limited by what the CPU can handle on top of its graphics processing.

A new chip set developed by Lockheed Martin in partnership with Sega is about to change all that. Lockheed Martin (a merger between Lockheed and Martin Marietta) has a long history of 3-D simulation. Their software has trained airline and fighter pilots, and was used to train tank crewmen in Operation Desert Storm.

Lockheed Martin's new chip set has off-loaded almost all the 3-D processing from the CPU to the graphics board, freeing up the CPU for other tasks. Standard graphics cards can draw perhaps 100,000 polygons per second on the screen. In contrast, the Lockheed Martin chip set can draw 750,000 polygons per second.

The result of this kind of processing power can already be seen in Sega's best-selling arcade game Daytona USA, which displays an incredibly realistic landscape as you manipulate the controls of a race car. New 3-D graphics cards that take advantage of the chip set are expected to appear in the beginning of 1996. The first cards will probably cost about $2,000.

How does all this relate to Microsoft's Games API? The Lockheed Martin chip set has been optimized to work with the 3-D DDI, so developers who use the Games SDK will have full access to its powerful features. Without a doubt, the games that will hit store shelves this holiday season will knock your socks off.—*Sheryl Canter*



With Microsoft's new Games SDK, developers will be able to directly access hardware features for acceleration and 3-D processing.

Briefs

IT'S A BUYER'S MARKET FOR ACTIVE-matrix liquid crystal displays (LCD). Sharp and Hitachi report that the cost of building an LCD screen, which contributes nearly 50 percent of the cost of most notebook PCs, has fallen from a January high of $1,200 to nearly half of that. The result should be cheaper notebooks and better displays on mid-range and low-end notebooks.

MICROSOFT HAS UNVEILED ITS OLE controls for the Macintosh API, which allows for the same kinds of OLE object controls as Windows-based OLE controls. Microsoft has demonstrated scrolling wallpaper, a scrolling document, and an on-screen clock—all operating as separate OLE controls. Developers can look forward to building "script-once" OLE controls that will work across platforms. Developer's kits are expected to show up toward the end of this year.—*Sebastian Rupley*

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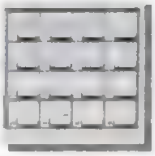

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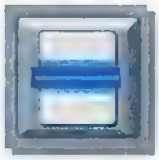

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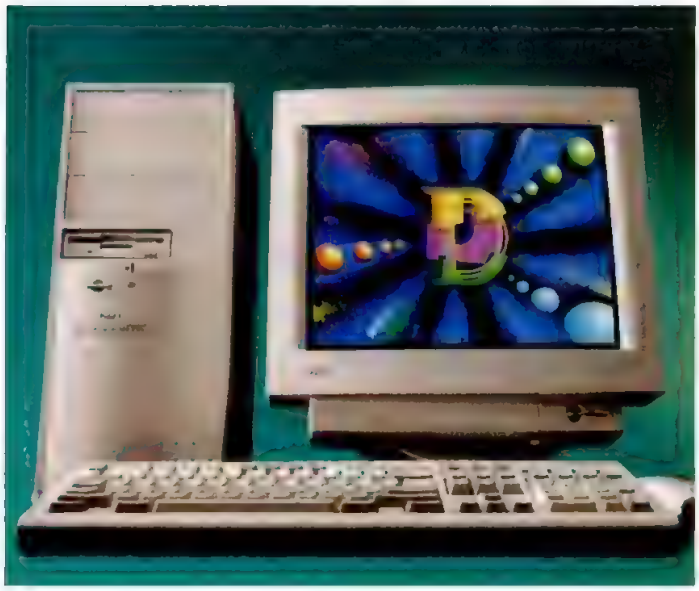

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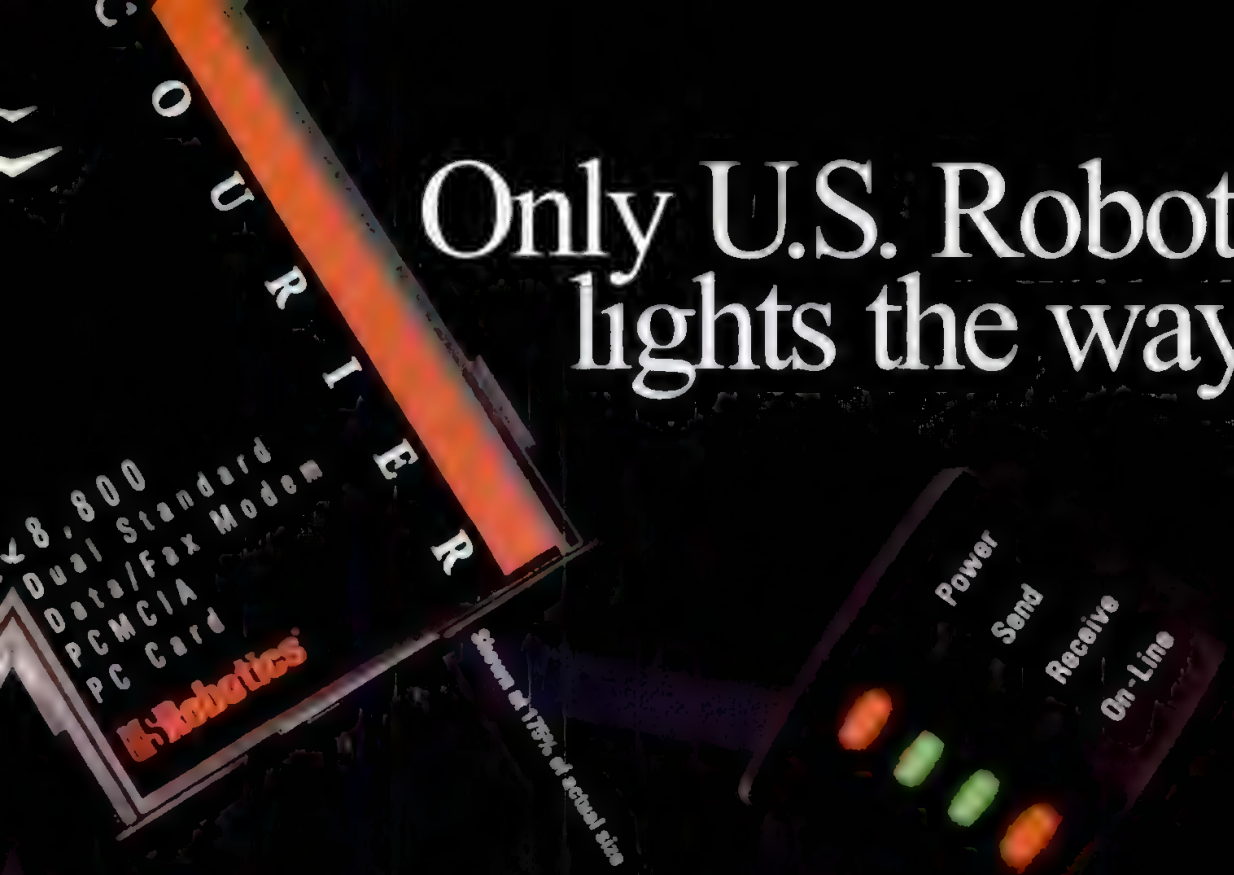

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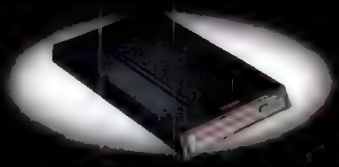

PC MAGAZINE EDITOR'S CHOICE

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

INTERNET ACCESS

Big Three On-Line Services Reach Out to the Internet

By J.W. Olsen

The past year has witnessed a race to the Internet finish line among the traditional Big Three on-line services. America Online, CompuServe Information Service, and Prodigy all offer varying degrees of Internet access, but if you demand the most from the Internet or spend a lot of time on the World-Wide Web, you should place your bet on an exclusive Internet provider.

Internet first-timers or less intense users, however, may find many of their favorite Internet features within friendly surroundings by choosing carefully. While the interfaces are free, each of the services charges between two and three dollars per hour on the Net.

COMPUSERVE

The CompuServe Information Manager for Windows, Version 1.4 (WinCIM 1.4) is the cornerstone of the on-line service's aggressive strategy to provide enhanced interaction with both the Internet and CompuServe's own emerging hypertext interface.

In addition to augmenting WinCIM's CompuServe abilities, this updated interface continues to provide direct access to the Internet's telnet, FTP, and UseNet capabilities. Selecting WinCIM's Internet icon leads to a window with buttons for each Internet capability, plus a scroll bar of related resources, including CompuServe's own Internet discussion forums and help files. These resources can help, but aren't as substantial as those provided by the other services.

EASY ON, EASY OFF: *Navigate within America Online's Internet Connection via multiple well-designed steps.*

The UseNet window leads you to a variety of related newsgroups. The number and organization of these newsgroups make them a joy to use, but you're restricted to CompuServe's choices.

In place of an integrated Web browser, WinCIM contains a proprietary version of CompuServe-owned Spry's browser. The Spry browser provides all the basics, but requires a separate log-on. The browser includes WinSock

Continues on page 38

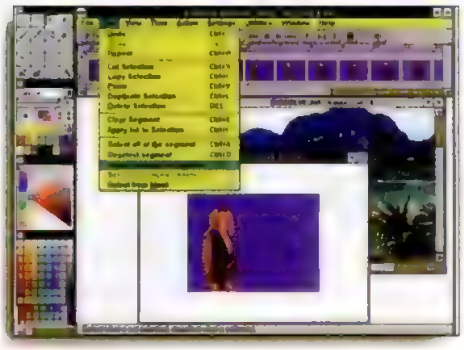
ANIMATION

Animator Studio: The Windows Cartooning Machine

By Luisa Simone

With the release of Animator Studio, Autodesk consolidates its leading position in the PC-based cartooning and animation market. This $795 raster-based two-dimensional animation program combines the best features of its DOS-based predecessor (Animator Pro) with all the multimedia capabilities of Windows.

The most obvious difference between the two programs is Animator Studio's integrated Windows interface. Rather than shuffling between different (and sometimes idiosyncratic) modules for titling, motion path, tweening, and tracing functions, you simply click the appropriate item in a toolbox, ribbon bar, or drop-down menu.



STICK WITH IT: *Animator Studio's selection tools affect a movie frame by frame.*

The revamped interface delivers more understandable icons and configuration options. The result is a program that is easier to navigate and more powerful to use. For example, to move through an animation sequence, you simply select a frame from the filmstrip that runs along the top of the workspace.

Animator Studio's integrated workspace allows better interaction among the various functions. The program offers all of the titling functions found in Animator Pro, but because it is implemented as a standard tool you can now combine titling effects (like scrolling text) with optical effects (like rotations) with stunning results.

Less obvious but equally significant are the additions of floating objects and selection tools, which replace Animator Pro's sometimes awkward use of multiframe cells. As with multiframe cells, you can use a floating object as an animation sprite (pasting it along a freeform path) or with keyframes (where Animator interpolates movement for the in-between frames).

Floating objects also come into play when you use standard animation techniques such as onion-

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On-Line Internet Access

Continued from page 37

support, so that you can bypass CompuServe altogether and connect to the Web directly.

WinCIM seems more at home on your Windows desktop than either of the other two programs. For example, after downloading an Acrobat file from the Web, File|Open automatically launched the Acrobat viewer displaying the file.

ALL TOGETHER NOW: *All WinCIM Internet functionality is accessible from a central menu.*

In addition, WinCIM is the only product here that can send binary Internet e-mail to other supporting on-line services, such as MCI Mail. Unfortunately, WinCIM still can't execute scripts prepared off-line, so you have to navigate the service while on-line, which costs time and money.

CompuServe charges $9.95 per month for three hours of Internet use, and has volume discount plans. The Spry browser brings the Web to CompuServe users but falls short of true integration.

AMERICA ONLINE

America Online was the first of the Big Three to include Internet access, and with America Online for Windows 2.0, the service takes the lead with a strikingly attractive, well organized program.

The first thing you'll notice about AOL on the Net is that, like the on-line service itself, content is organized into broad subject areas like Entertainment, Personal Finance, Today's News, and Internet. This streamlines navigation without reducing content.

Click on the Internet connection button and Internet choices appear: mail gateways, Newsgroups, Gopher and WAIS databases, Internet mailing lists, and FTP. But oddly, the Internet mail gateway also must be used to access Veronica, Jughead, and Archie for searching.

As you pass through each level of the interface, you'll find a variety of resource files and discussion areas based on the current subject matter. For example, you can learn what FTP is and how to find remote FTP sites before transferring. But it's what's missing that counts. AOL was putting the finishing touches on its Web browser during the testing phase of this review. The preview software we looked at was downloadable free of charge and was solid and dependable. It also compresses the data it sends to your PC to speed the data flow. The Web browser should be ready by summer.

For most activities you must be on-line and on the clock, however. While you can compose messages off-line, to capture incoming messages to read later you must run a FlashSession, which logs on, performs a scripted sequence of activities, and automatically logs off. What you can do in these sequences is highly limited.

Like CompuServe, AOL charges $9.95 per month, but that includes five hours on the Net. AOL offers the most elegant and friendly Internet interface of the Big Three, but it falls short due to its lack of a Web browser.

PRODIGY

The first service with a Web browser, Prodigy still leads in some ways but in others its interface is hopelessly outdated. Like AOL, Prodigy's Version 1.1 interface has buttons that let you choose among content areas. You move layer by layer to the area of your choice. But unlike AOL, Prodigy employs full-screen displays, not MDI windows.

Once at Prodigy's Web site, you're not limited to manually entering sites for FTP and other Internet features; there are a multitude of links to remote sites. And Prodigy's browser is the only one that can send Internet mail from a handy pull-down menu.

E-MAIL EXPRESS: *Prodigy's Web browser offers a pull-down e-mail menu for easy messaging.*

But Prodigy's interface is often disconcerting and cluttered. To some degree, its integration makes up for this. For example, some links on a weather page might jump to Prodigy's own weather bulletin boards; others take you to the National Weather Service. Later this year, Prodigy expects to convert its content into Hypertext Markup Language (HTML) and will offer an authoring tool.

You can do little off-line—not even compose e-mail. However, complementary products from Prodigy perform significant off-line work. A proprietary version of ConnectSoft's E-Mail Connection ($14.95) can manage Internet mail off-line, while Bulletin Board Note Manager ($19.95) lets you navigate bulletin boards and compose replies.

Prodigy charges $9.95 for five hours of connection time per month. The first to bring the Web's magic to an on-line service, Prodigy is now playing catch-up.

INTERNET DECISIONS

Which way to go? None of the Big Three on-line services has it all. CompuServe comes close, but treats the Web as an add-on. Prodigy is the furthest behind in terms of ease of use, but offers many interesting locales from its Web page. AOL has the best look and feel and is the easiest to navigate, but its bridge to the Web is still under construction.

Treat these Internet efforts as works in progress that will mature and provide a richer array of services. For now, none offers the ease of use and depth required of a dedicated Internet provider.

America Online for Windows 2.0. *Requires: 4MB RAM, 3MB hard disk space, Microsoft Windows 3.1 or later. America Online Inc., Vienna, VA; 800-827-6364, 703-448-8700.*

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CompuServe Information Manager for Windows, Version 1.4. *Requires: 4MB RAM, 6MB hard disk space, Microsoft Windows 3.1 or later. CompuServe Inc., Columbus, OH; 800-524-3388, ext. 664.*

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Prodigy. *Requires: 4MB RAM, 5MB hard disk space, Microsoft Windows 3.1 or later. Prodigy Services Co., White Plains, NY; 800-776-3449, 914-448-8000.*

Circle 425 on reader service card

On-Line Internet Access: Side by Side by Side

None of the Big Three on-line services offer a clean sweep of Internet service, but America Online (AOL) comes closest and provides an uncluttered way of navigating from place to place.

■ YES ▨ NO	AOL	CompuServe	Prodigy
World-Wide Web	▨ [1]	Optional [2]	■
FTP	■	■	▨ [3]
Gopher	■	Optional [2]	▨ [3]
Veronica	■	Optional [2]	▨ [3]
UseNet newsgroups	■	■	▨ [3]
WAIS	■	Optional [2]	▨ [3]
Telnet	▨ [4]	■	▨
Binary e-mail	▨	■	▨ [4]

1 Announced for this year (the preview version is available on-line)
2 Additional software from the service is required
3 Indirectly available through the service's Web browser
4 Announced for this year

Animator Studio

Continued from page 37

skin tracing, where the program simulates tracing paper for the drawing of a moving object from frame to frame. Animator Studio's onionskin feature is unique because it lets you float whatever you've drawn in the current frame to fine-tune its shape or position before you render it. Animator Studio can even maintain your brushstrokes as a floating object and paint them incrementally over time—making it easy to create moving line graphs or traveling map routes.

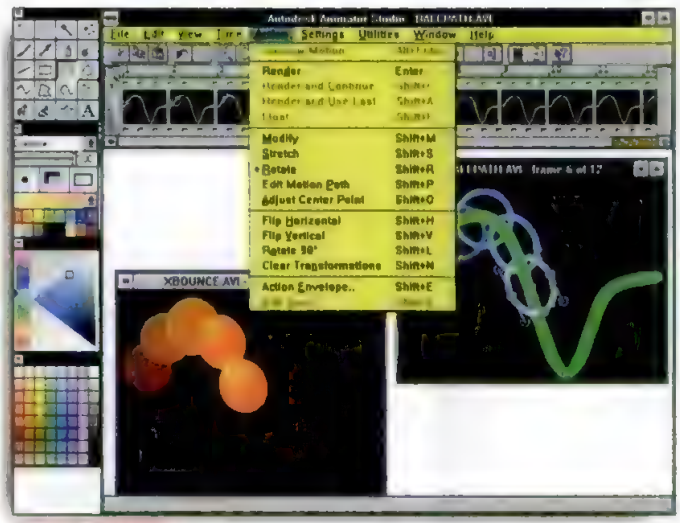
Because they are geared to animation, the marquee, lasso, and magic wand tools work over a sequence of frames. For instance, we selected the solid color background behind a moving figure by using the magic wand, and Animator Studio isolated the figure from the background for the duration of a movie. These techniques are powerful compositing tools when used with other features—letting you, for example, invert a selection or build a mask based on the current selection.

Several of Animator Pro's advanced motion tools have been tweaked in Animator Studio. You can still control the speed of a motion effect with push-button options like slow-in or ping-pong. But you have much greater control if you employ the new action envelopes. Action envelopes work similarly to gray maps in image editing programs. Reshaping a curve lets you vary the speed (and even the direction) of an object's motion over time.

STEP BACKWARDS?

Long-time Animator users may be disappointed by the loss of a few key features, such as reusable motion paths. Animator Studio can record a motion path as a macro, but the coordinates are absolute, not relative. Thus, creating effects like traveling shadows is awkward. And though tweening (the process of interpolating from one shape to another) has been made more accessible, you cannot add or remove vertices between the beginning and ending shape.

Animator Studio takes advantage of the Windows environment in a number of ways. First and foremost is support for multimedia pictures and sounds. In addition to standard still-image formats (such as .GIF, JPEG, Targa, and TIFF) and Autodesk's own cartoon format (.FLI and .FLC), Animator Studio can read and write .AVI and QuickTime files.



TRACING PICTURES: *Improving on onionskin animation techniques, Animator Studio lets you float and modify an object.*

Though Animator Studio can play back prerecorded sounds, you must use Animator Sound Lab to create a movie soundtrack. Sound Lab isn't a full-featured .WAV file editor. For example, it doesn't support multiple audio tracks; instead, you must paste mix sounds together into a single audio track.

The features that Sound Lab does provide, however, are useful and downright fun. Generating synchronized sound effects is a snap because you can play the animation while you record the audio. A handful of filter effects let you fix common problems (such as low volume) or create special effects (such as reverberation). The ability to change the pitch without changing the tempo was useful for recording a voice normally and turning it into a demon's boom or a mousy squeak without losing synchronization.

The move to Windows has other benefits as well. Instead of the 256-color limit imposed by most animation programs, Animator Studio supports 24-bit color. It also improves traditional cartooning techniques by providing better transparency effects and better color interpolation for gradient fills. Animator Studio also takes advantage of standard protocols—like the Adobe Plug-In specification—to extend the program's functionality. Animator Studio ships with a custom version of Kai's PowerTools that includes filters for Find Edges, Charcoal, or Pixel Storm effects that appear on the menu as one of Animator's ink choices.

Our testing revealed several shortcomings in the program. Chief among them was the use of the Windows Clipboard for all compositing operations. If you are working with limited memory resources and large movies, you'll find that you'll have to work with shorter frame segments to achieve overlay effects. In addition, Autodesk has developed its own 24-bit RLE video-compression scheme that allows you to work over several different sessions without degrading image quality; larger files require lots of disk space and performance can slow considerably.

SOUND TRACK: *Add appropriate—or appropriately wacky—sound effects with Sound Lab.*

COMPRESSION CHOICES

When you are ready to distribute your masterpiece, you can save it using the higher compression ratios offered by the Indeo and Cinepack Codecs or by 8-bit formats such as Microsoft RLE, .AVI, and Autodesk Flic. Animator Studio also fails to provide video-oriented functions, such as NTSC gamut alarms or control over video fields at output time.

On a broader level, Animator Studio doesn't offer features found in other programs; for instance, there's no support for the multiple keyframes of high-end 3-D animation programs. It also doesn't have the superimposition tracks found in video-editing software. And Animator Studio can't maintain multiple floating objects simultaneously, as can vector-oriented animation programs.

These aren't problems per se. But they do signal Animator Studio's role as a creation tool that is intended to supplement—not replace—video-editing or multimedia-authoring software. Indeed, the only way to create a full-blown presentation with Animator Studio is to use the included Animator Scriptor utility. You can string together still pictures and animations, add playback controls such as loop or go-to markers, and even play MIDI files in the background. But you must use another bundled utility—Animator Player—to execute the script files.

Given Animator Studio's role as a creation tool, there is no two-dimensional animation program available today that can beat its flexible and artistic toolset.

Autodesk Animator Studio, Release 1. *List price: $795. Requires: 16MB RAM, 40MB hard disk space, Microsoft Windows 3.1 or later, Windows-compatible sound card, microphone. Autodesk Inc., San Rafael, CA; 800-879-4233, 415-507-5000; fax, 415-507-5100.*

Circle 426 on reader service card

CD-ROM DRIVES

Six-Speed CD-ROMs: For Heavy Data-Lifting Chores

By Alfred Poor

Plextor and NEC are the first to ship the next generation of CD-ROM drives, which run at six times the speed of a standard audio CD drive. Both models deliver near megabyte-per-second throughput and are sure to appeal to prospective buyers. A closer look indicates that these drives make more sense for those who routinely move large files off a CD than for those who watch video clips on their PCs.

VIDEO DRIVE: *The 6PleX CD-ROM drive comes with video acceleration drivers.*

There are many similarities between the two drives: Both the Plextor 6PleX PX-63CS and the NEC MultiSpin 6Xe sell for $599, use SCSI-2 interfaces to move data off the disk, hold the CD in a disk caddy, and have audio controls in the front. While the Plextor 6PleX is an internal drive (an external drive is available for $689), the NEC MultiSpin 6Xe is an external drive that has an LCD display that provides useful status information about the disk in use (NEC sells an internal version for $499).

The real news is inside the case. Both drives are rated at a sustained data-transfer speed of 900 kilobytes per second (KBps) and a full-stroke access time of 250 milliseconds (ms). The Plextor has the edge with a claimed one-third-stroke random-seek response time of 115 ms, compared with 130 ms for the NEC drive. Both drives come with a 256K data buffer.

We found that both drives managed throughput scores of about 900 KBps in the PC Labs CDBench tests. The NEC drive had a negligibly slower data-transfer rate compared with the Plextor drive. These results were 50 percent greater than the average for quad-speed drives of 599 KBps (see "The Newest Spin on CD-ROM Drives," March 28, 1995).

It was in the one-half-stroke seek-and-read test where the Plextor drive set the pace with a time of 212 ms; the NEC was slightly behind at 252 ms. These scores were considerably slower than the manufacturers' specifications, which are based on a one-third-stroke test. The Plextor's score was about 30 percent faster than the average score for the quad-speed drives, and the NEC's score was slightly slower than average.

Under Video for Windows, using an Indeo clip requiring a 150-KBps transfer rate, tests with both drives on a 90-MHz Pentium yielded no dropped frames out of 912 frames and no audio breaks. A Cinepak clip requiring 600-KBps throughput did not fare as well; the 6PleX dropped 2 frames out of 599, while the MultiSpin 6Xe dropped 3 frames; neither had any audio breaks. (We also retested the 4PleX model from our article of March 28, 1995, and found that contrary to the information printed in the story, the drive did not have any trouble reading with our test CD-R disk.)

Plextor has improved digitized video-clip playback with a new software driver. Designed to work only with Plextor drives, it accelerates performance for QuickTime, Video for Windows, and software-decoded MPEG video clips by addressing functions of the Plextor drives that are not currently supported by other drivers.

For its part, NEC has the industry's first self-cleaning lens. More importantly, the MultiSpin 6Xe drive complies with Microsoft's Plug and Play specification. So a suitably equipped system should be able to recognize, install, and configure the new drive automatically. After several hours of tech support, we were not able to properly configure the NEC drive using the supplied Adaptec SCSI board. We tested the drive with a plug-and-play Future Domain SCSI board without incident.

WHAT'S UP: *The MultiSpin 6Xe features an LCD screen that displays drive information.*

Both drives offer equivalent data throughput. The 6PleX's faster access time and added video driver support, however, give it the performance edge. In case you're looking to save a little money, the comparable MultiSpin drives—whether internal or external—cost about $100 less.

WHY BOTHER?

The big question is whether there is an advantage to the extra speed offered by these drives over quad-speed ones. If you use mostly multimedia applications, you probably won't see much of a performance gain, since most titles are still designed for data throughput to match either single- or dual-speed drives. Until CD titles are keyed to the higher data rates that these drives are capable of, the extra video abilities of a 6X drive will be minor.

The biggest gains will be seen by those who regularly load large files such as graphics images or text databases. Then the extra speed of a 6X drive may pay off.

6PleX PX-63CS Internal Drive. *List price: $599. Plextor, Santa Clara, CA; 800-475-3986, 408-980-1838; fax, 408-986-1010.*

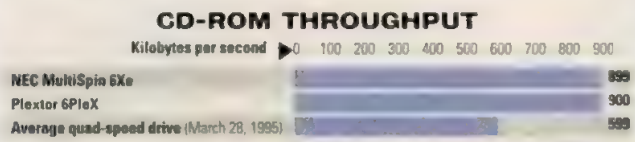
Circle 427 on reader service card

BENCHMARK TESTS

Six-Speed CD-ROM Drives

Give or take a kilobyte per second of data throughput, both the Plextor 6PleX and NEC MultiSpin 6Xe CD-ROM drives achieved true six-speed performance. The two were separated by their one-half-stroke Seek-and-Read Access times. The Plextor drive achieved a 212-millisecond timing, while the NEC had a slower 252-ms timing.

We tested both drives with PC Labs' CD Bench, Version 1.08, on a 90-MHz Pentium PC with 16MB of RAM



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PCs

IBM's a Day Late and Several Dollars Short with Its PC 350

By Tin Albano

In the past year or so we've been introduced to six different Pentium processors with speed limits of between 60 and 120 MHz. Before the next new speed increment comes along and shakes up the newly formed performance/price niches, a mini-price war in the entry-level Pentium desktop PC arena is developing. The big players in this market—Dell, Gateway, Hewlett-Packard, and Micron—have aggressively lowered the price tags on their 75- and 90-MHz entry-level Pentium-based systems.

The goal is a price point of around $2,700 for a 90-MHz Pentium PC with 16MB RAM, an 850MB or larger hard disk, and a quad-speed CD-ROM drive. IBM, however, priced its comparably equipped PC 350-P90 at $3,299, missing the mark by several hundred dollars.

BRIDGING THE GAP

How does IBM make up for this price gap? Flexibility seems to be their answer. All IBM PC 350 systems come with a dual-formatted hard disk drive that lets you choose between booting the system with either Windows or OS/2 Warp operating systems. In addition, IBM's SelectaBus technology puts the PC's bus circuitry on a removable riser card so that in the future you can quickly change the bus architecture of the system. The PC 350 is based on Intel's Triton chip set so it can accommodate performance-enhancing EDO memory; our test system came with standard DRAM chips.

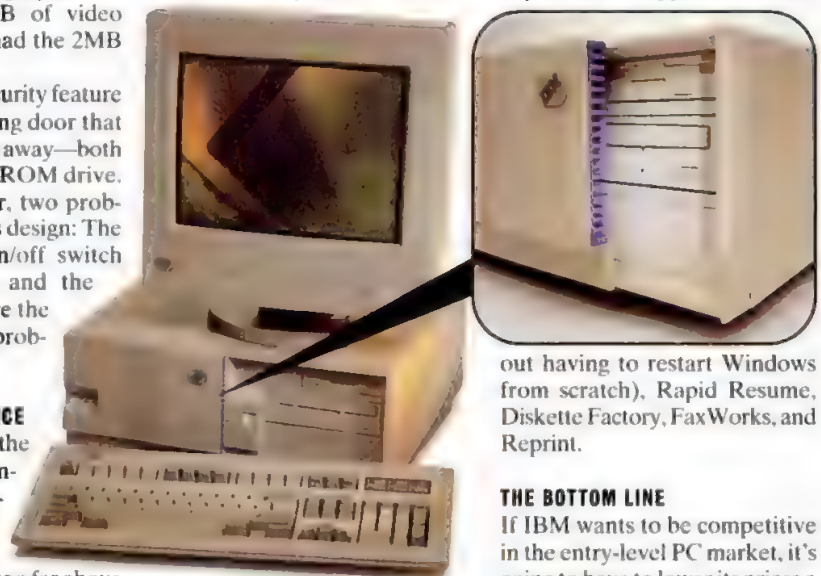
The PC 350's desktop case has five drive bays (two of which are occupied) and five expansion slots (three ISA, one PCI, one ISA/PCI). IBM's Pentium-equipped PC 350s come standard with a PCI-based S3 graphics accelerator with 1MB of video memory (our unit had the 2MB option installed).

An interesting security feature is the PC 350's sliding door that can cover—and lock away—both the floppy and CD-ROM drive. There are, however, two problems with the door's design: The door leaves the on/off switch readily accessible, and the lock is located where the monitor's base will probably sit.

MIDPACK PERFORMANCE

During our testing, the 90-MHz Pentium-equipped PC 350 system turned in good, competitive results, never straying too far above or below the average mark. The IBM unit managed a Winstone 95 score of 136, versus the average of 133 for the five 90-MHz Pentium PCs we tested in "Tapping the Promise of Pentium" (May 30, 1995). The PC 350's above-average results on the Disk WinMark 95, DOSMark, DOS Video, and DOS Disk tests were balanced by below-average scores on the Graphics WinMark 95 and $CPUMark_{16}$ benchmark tests. Steady and predictable, the overall performance of the system was not impressive.

Usability and friendliness were also on IBM's mind when it came time to pack its PC 350 system with software. In fact, the system ships with one of the most comprehensive sets of programs for business buyers.



MEDIA SECURITY: *IBM's PC 350 line of Pentium based desktop computers have a sliding door (see inset) to keep away unwanted media.*

IBM's own Easy Tools software package helps to orient new users with the system as well as with the operating system they choose to run. With Easy Tools comes Online Housecall, which you can use to access on-line technical help from IBM or from your own corporation's help desk. The Wake Up On Ring utility automatically activates your computer whenever its phoneline begins ringing. The system also came with the client software for NetFinity, a network utility that monitors a PC located on a LAN.

There's also a good set of utilities bundled with the PC 350 system. These include DiagSoft's QA Plus diagnostic software, Binar's AnyView (which lets you switch video resolution and color depth between applications without having to restart Windows from scratch), Rapid Resume, Diskette Factory, FaxWorks, and Reprint.

THE BOTTOM LINE

If IBM wants to be competitive in the entry-level PC market, it's going to have to lower its prices a bit, or somehow increase the performance of its 90-MHz PC. IBM does offer a 75-MHz-based Pentium PC 350 with a more tempting price point of $1,995 (540MB hard disk, 8MB RAM, 14-inch monitor), but they're not alone in breaking through the $2,000 price floor with a 75-MHz Pentium PC.

The IBM PC 350-P90 is a solid machine, capable of reliable operation and packed with a plethora of useful software—but the $500 or more you can save by shopping around can buy you a handful of the latest CD-ROMs and a high-speed modem to boot.

IBM PC 350-P90. *List Price: With 90-MHz Pentium CPU, 16MB RAM, 256K of external cache, 850MB hard disk, quad-speed CD-ROM, 15-inch monitor, $3,299. IBM Personal Computer Co., Somers, NY; 800-426-2968; faxback, 800-426-4329.*

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BENCHMARK TESTS

IBM PC 350-P90

The IBM PC 350-P90's test results didn't stray very far from the average scores garnered by the Pentium/90 systems we tested for our issue of May 30, 1995. The unit's slightly above-average results on our Winstone 95, Disk WinMark 95, DOS Video, and DOS Disk tests were offset by subpar scores on our Graphics WinMark 95 and $CPUMark_{16}$ tests.

We used Winstone 95, Version 1.0; WinBench 95, Version 1.0; and PC Bench, Version 9.0, to gauge the performance of this desktop PC. The system was equipped with 16MB of RAM.

Higher scores represent better performance.	Winstone 95	Graphics WinMark 95 (Mpixels/sec)	Disk WinMark 95	DOSMark	$CPUMark_{16}$	DOS Video	DOS Disk
IBM PC 350-P90 (Pentium/90)	136	11.4	747	986	188	5,092	681
Pentium/90 average (May 30, 1995)	133	12.2	667	855	190	3,371	672

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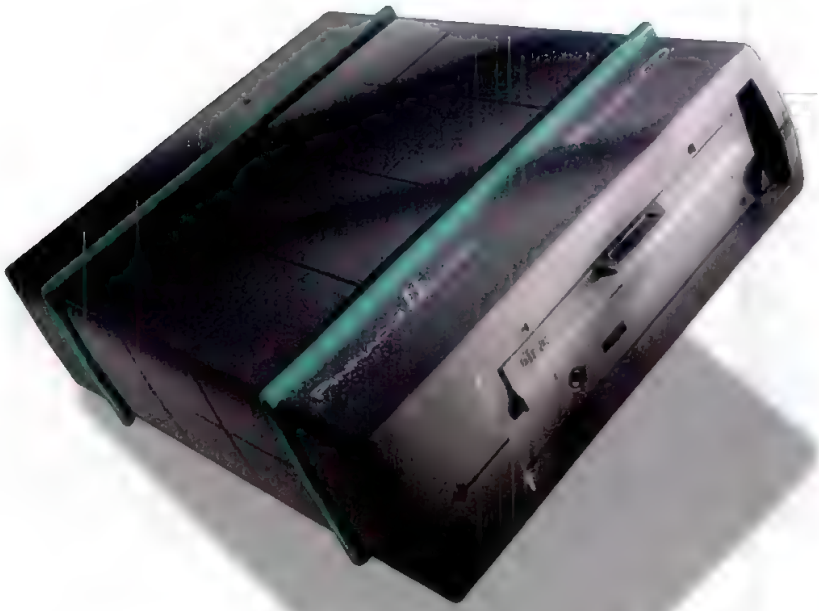

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MPEG AUTHORING

RealMagic Producer Directs a Practical Video Solution

By Jan Ozer

Sigma Designs' RealMagic Producer is an ambitious, market-defining product that, despite several quirks, delivers on its promise to capture, edit, and compress video inexpensively and in near-real time. The $4,995 hardware/software package slips neatly between more expensive real-time professional MPEG compression systems and cheaper, slower compression solutions. MPEG producers who need to edit video of acceptable (though not broadcast) quality digitally should look no further.

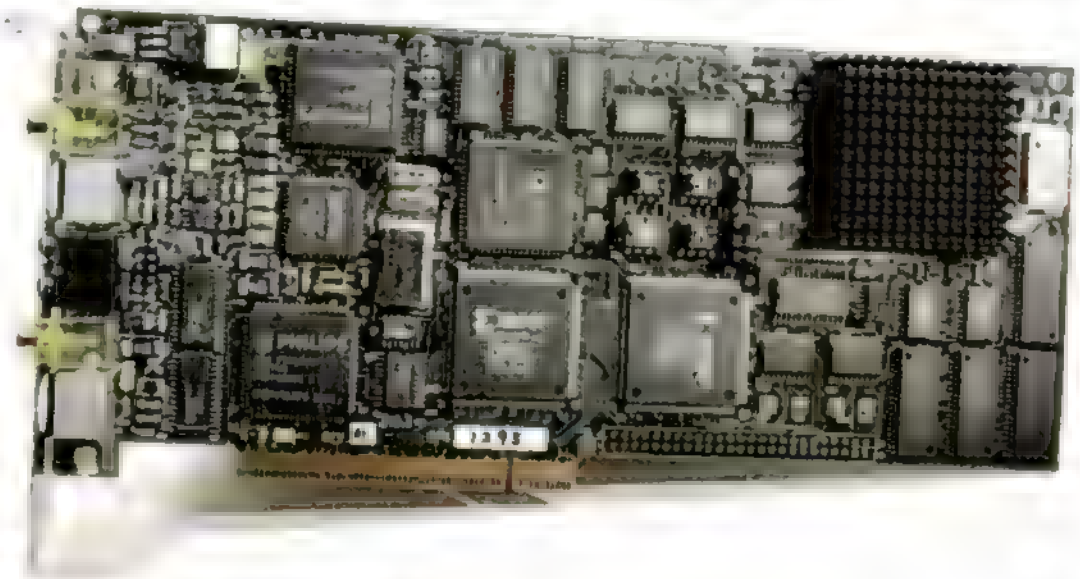
Before Producer, MPEG authoring was split into two camps: real-time systems that cost upwards of $50,000 from companies such as FutureTel, Optibase, and Optivision, and Video for Windows–based capture boards that cost from $1,500 to $3,000, took upwards of an hour to compress each minute of video, and produced inferior-quality video. Enter the PCI-based Producer package, the first commercial implementation of C-Cube's CLM-4100 MPEG accelerator chip. The board contains connectors for S-Video and Composite video input and output jacks, as well as audio input and output stereo jacks.

LIGHTS, CAMERA...

In addition to Sigma's capture and compression program, Producer comes with Adobe Premiere 4.0 for video editing, Caligari trueSpace 1.0 for creating 3-D graphics and animation, and Drastic Technologies' Animation Commander 2.0 for analog device control. System requirements are hefty but reasonable considering the disk- and processor-intensive nature of video. You'll need a Pentium CPU with at least 8MB of RAM, about 112MB of free disk space for the programs, a free serial port for external device control, and a RealMagic-compatible MPEG playback card. In practical terms, you'll also need at least a 1GB hard disk to store video clips.

We tested the Producer system on a Gateway 60-MHz Pentium PC with a 2GB SCSI Micropolis AV hard disk and a RealMagic MPEG playback board connected via overlay to an ATI Mach32 PCI video card. The hardest part of getting started was installing each individual program; a CD-ROM with a unified installation routine would have helped.

Producer's capture and compression interface is logically laid out and simplifies MPEG's two-step compression process of capturing and then compressing the video to final format and data rate. The board handles both NTSC (352- by 240-pixel resolution at 30 frames per second) and PAL (352- by 288-pixel resolution at 25 fps) formats, and can output in VideoCD (Whitebook), ISO 9660 (PC CD-ROM format), and CD-ROM XA (Greenbook) formats. Custom audio and video data rates are selectable with presets for single- and double-speed CD-ROM drives and Video CD.



LET'S GO TO THE VIDEOTAPE: *RealMagic's Producer board produces acceptable nonbroadcast-quality PC-based video.*

FINE-TUNING: *Producer's Encode screen allows customization of audio and video data rates for better playback.*

The program's Preview shows the quality you'll get with the selected data rate, but because the preview window is not available during capture, you'll need an NTSC monitor to see what's going on. Intuitive VCR-like buttons start and stop the capture process, which can be performed on-line or externally via the Animation Commander software. Animation Commander supports RS-422 serial devices, but not MCI protocols such as VISCA (Hi-8) and laserdisk.

...ACTION

The biggest failing of the Producer system is its limited bandwidth, which corresponds directly with the quality of the output video. With Producer's capture controls set to the maximum data rate of 13 megabits per second, the system achieved a throughput of only 725K per second—about half of Producer's promised bandwidth. No error messages were relayed, nor did we notice dropped frames; we simply hit the board's data ceiling. This was surprising given that the ISA-based Intel Smart Video Recorder Pro (First Looks, October, 25, 1994) delivered 761K per second on the same workstation.

Producer doesn't offer incoming color and brightness controls either, which are standard on $500 capture cards and often necessary to tune analog video for digital editing or to correct production errors. The capture software was annoying to use at times because it gave no warning before writing over an existing video clip.

Producer captures video using the motion-JPEG standard sequential I frame (or intra-frame) technique. Video and audio data are stored in separate files: video as a Video for Windows .AVI file and audio as a .WAV file. These files are then transcoded for synchronization to final MPEG format in Producer, which is the basis of Sigma's Editable MPEG format. We found that this dual-file format is a step backward from a Motion JPEG compressed .AVI file with interleaved audio when we started to edit in Premiere. Launching Premiere from Producer loads only the .AVI file, not the needed .WAV sound file.

Since Premiere cannot link cut-and-paste edits between audio and video files, normal editing operations like clipping excess video frames is a two-step process. Premiere also can't compress to final MPEG format—it can only produce an interleaved .AVI file that is transcoded in the Producer interface. Producer's compression times met the advertised 10 frames per second rate, which is about 20 times faster than Xing Technologies' XingCD software-only approach. Video quality was superior to XingCD 1.1's, but noisier and less clear than FutureTel's $15,000 PrimeView real-time MPEG board. Audio quality was quite good, although there was some distortion in one of the test clips we viewed.

Despite several shortcomings and its occasionally complicated operation, Producer delivers acceptable MPEG performance and quality at a price that's hard to resist.

RealMagic Producer. *List price: $4,995. Requires: 8MB RAM, 112MB hard disk space, PCI slot, RealMagic-compatible MPEG playback card, Microsoft Windows 3.1 or later. Sigma Designs Inc., Fremont, CA; 510-770-0100; fax, 510-770-2640.*

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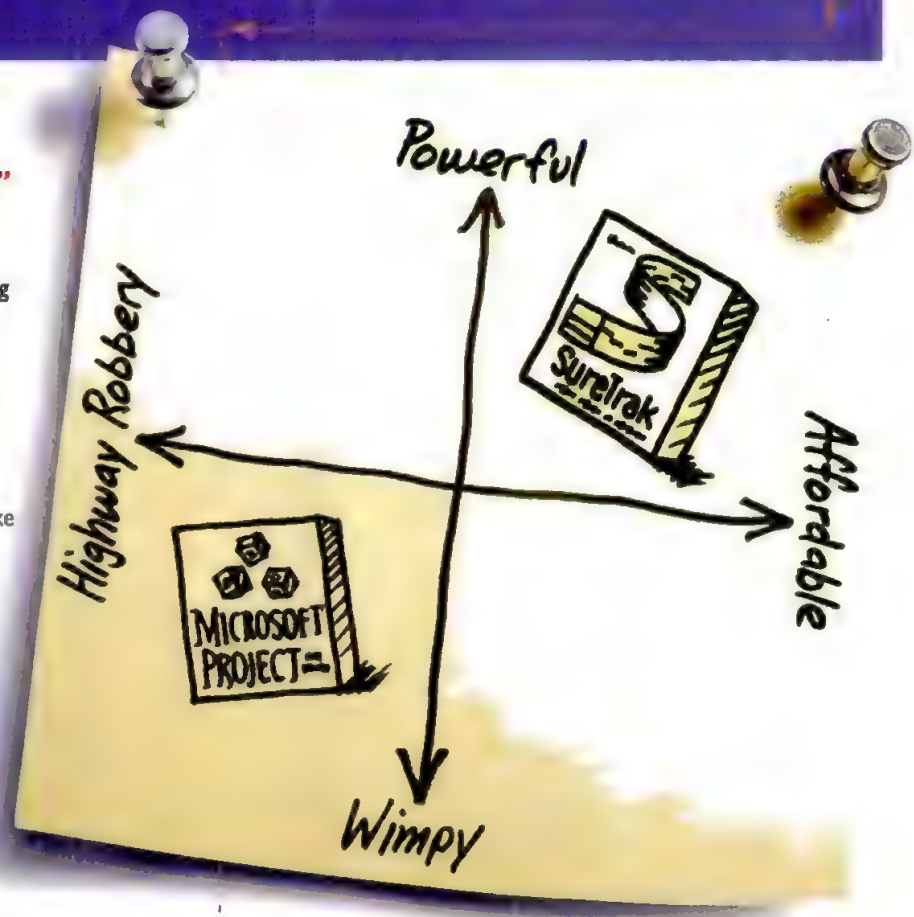

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CIRCLE 148 ON READER SERVICE CARD

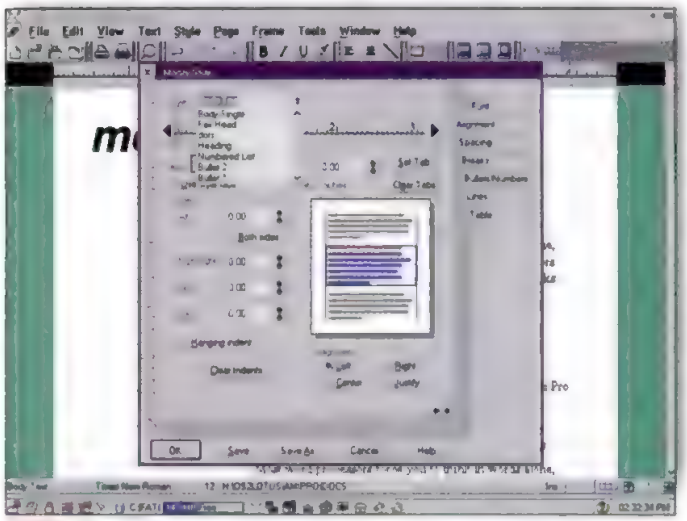
OS/2 APPLICATION SUITES

Lotus's SmartSuite 2.0 for OS/2: Let Them Eat Version Numbers

By Edward Mendelson

OS/2 users waiting for a new version of Lotus's SmartSuite should restrain their excitement over the arrival of Version 2.0. With an estimated selling price of $179, SmartSuite 2.0 for OS/2 is more of a marketing maneuver than a breakthrough in personal computing for the only suite of OS/2 applications available. It is essentially the same package as Version 1.1, except that the Value Pack add-ons now come in the box instead of as a $10 option.

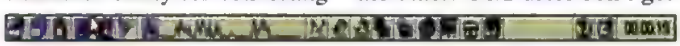
SmartSuite 2.0 for OS/2 consists of Ami Pro, Version 3.0b; Lotus 1-2-3, Release 2.1; Freelance Graphics, Release 2.1; and a single-user client portion of cc:Mail, Version 1.03. The bottom line is that if you already have SmartSuite 1.1 and the Value Pack, you won't gain anything except some slightly updated files by paying $10 to upgrade.



NATIVE: *The OS/2 version of Ami Pro looks like a native OS/2 application rather than a port from a Windows app.*

The main feature in the Value Pack add-on is SmartCenter, a graphical control panel for the Workplace Shell that resembles OS/2 Warp's LaunchPad but sits unobtrusively at the foot of the screen. Like the status bar on other Lotus products, SmartCenter has fields that change their function when you click on them. A free-space indicator changes into a system-usage monitor; a clock turns into a timer. You can drag frequently used applications to an application bar, and use other icons to open folders, switch among applications, and lock or shut down the system.

The package also includes macros for integrating Ami Pro with the other applications and a translator utility for converting files between Windows and OS/2 versions of 1-2-3 and Freelance. While useful, these converters obviously belong in the applications themselves.



BOTTOM LINE: *The SmartCenter utility—from which applications can be launched—sits at the foot of the OS/2 screen.*

Lotus hasn't supplied a common installation program for the suite and makes you install all the components from floppy disks, a time-wasting task at best. Windows users can load SmartSuite from a CD-ROM in a matter of 15 to 20 minutes. But you will probably find the most annoying aspect of SmartSuite to be Version 2.0's failure to integrate the Value Pack with the other applications. For example, after installing Freelance, you install the Value Pack separately to add more presentation templates.

For the most part, the separate programs in Lotus's OS/2 suite lag behind their Windows cousins, although they include strong support for the object-oriented features of the OS/2 Workplace Shell. Unfortunately, these components won't match the Windows versions until this summer.

The OS/2 version of Ami Pro, however, is the exception. It is based on thoroughly rewritten code that will be the basis for future Windows and OS/2 versions. The biggest advance is that the OS/2 version of Ami Pro lets you edit separate parts of the same file in different Windows—a feature not available in Ami Pro for Windows (although it is built into Word for Windows).

The OS/2 version uses the same file format as the Windows version, but doesn't include Ami Pro for Windows' tools for creating or modifying graphics and charts. Macros written for the OS/2 version support REXX commands. The first release of Ami Pro 3.*x* for OS/2 was sluggish and unstable, but the latest version is fast and solid.

Freelance Graphics for OS/2 has a slightly dated look similar to that of the Windows version. It's basically the same easy-to-use program, although you'll have to run the separate converter utility to move files from one version to the other. OS/2 users don't get the tutorial or the multimedia support that comes with the Windows version.

Lotus is the only major vendor that gives OS/2 users a set of integrated applications, and that's a lot to be grateful for. But rather than giving SmartSuite users the upgrade they've been waiting for, Lotus just gave them a new version number.

Lotus SmartSuite 2.0 for OS/2. *Estimated street price: $179. Requires: 12MB RAM under OS/2 2.1 (8MB RAM under OS/2 Warp), 36MB hard disk space, OS/2 2.1 or later. Lotus Development Corp., Cambridge, MA; 800-343-5414, 617-577-8500; fax, 617-693-4551.*

Circle 401 on reader service card

REXX Comes to Lotus 1-2-3

If you've felt limited by the primitive nature of 1-2-3 for OS/2's macro language and you're proficient in IBM's REXX programming language, Lotus has good news for you. A new REXXLink DLL in Lotus 1-2-3 allows you to create custom macro commands and worksheet functions in REXX.

Sadly, you won't find any documentation or help text to teach you how to work with this versatile programming language. But Lotus does supply a sample worksheet to show you some of the possibilities and help get you started.

Not much else is new in the SmartSuite 2.0 incarnation of 1-2-3 for OS/2. You can now fully translate between Release 4 or Release 5 of 1-2-3 for Windows and the OS/2 product, but the conversion is rudimentary and inconveniently implemented. You will have to run a separate Translate program to get the job done, and .WK4 applications that rely on 1-2-3/W's newest features (such as Version Manager, maps, or the command-equivalent macro verbs) may be completely unrecognizable on arrival in 1-2-3 for OS/2.

BRINGING IT ALL TOGETHER: *The REXX programming language ties SmartSuite together.*

Still, for those who need either the translator or REXXLink, SmartSuite makes sense.—*Craig Stinson*

DOCUMENT MANAGEMENT

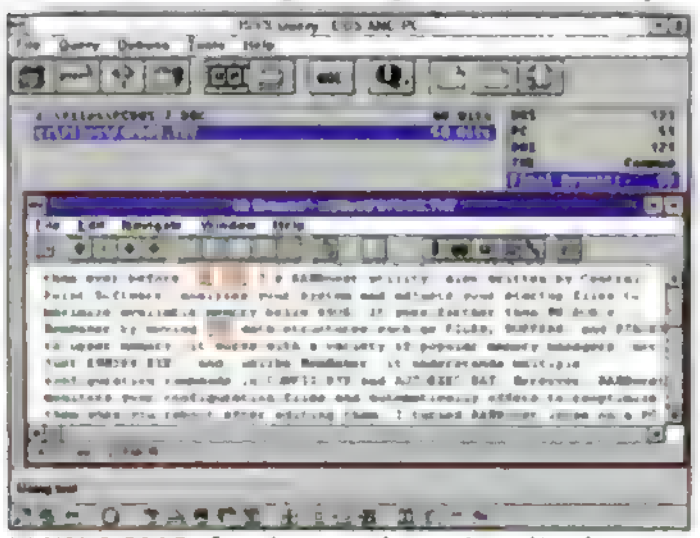
Isys and ZyIndex: Search and Rescue For Those Adrift in a Sea of Data

By David Haskin

Gathering a sea of information in the computer age is easy—not drowning in it is the hard part. The $435 Isys for Windows 4.0 and the $395 ZyIndex for Windows 5.2 are new releases of well-established text-retrieval programs that provide powerful data-sifting tools. While they are outwardly similar, we found that Isys was easier to use but ZyIndex was more powerful at searching the nooks and crannies of a hard disk to find information.

INDEX AND SEARCH

Both Isys and ZyIndex use separate modules to index data files. Indexing greatly increases search speed by establishing separate files that have pointers to a file's pertinent information. These programs share the same failing: You must wade through a series of often confusing dialog boxes to get the indexing process underway.



IN YOUR FACE: *Isys's search engine displays the file with native formatting intact.*

The first step is to choose which files you want to index. Both of these programs can automatically determine file formats, which is useful if you want to include a variety of different files in the indexing process. In our tests, the automatic format-sensing worked reliably and didn't noticeably slow the indexing process in either product. Isys includes a Wizard to walk you through the indexing process, but it is helpful only for quick tasks, such as indexing all files in a single directory.

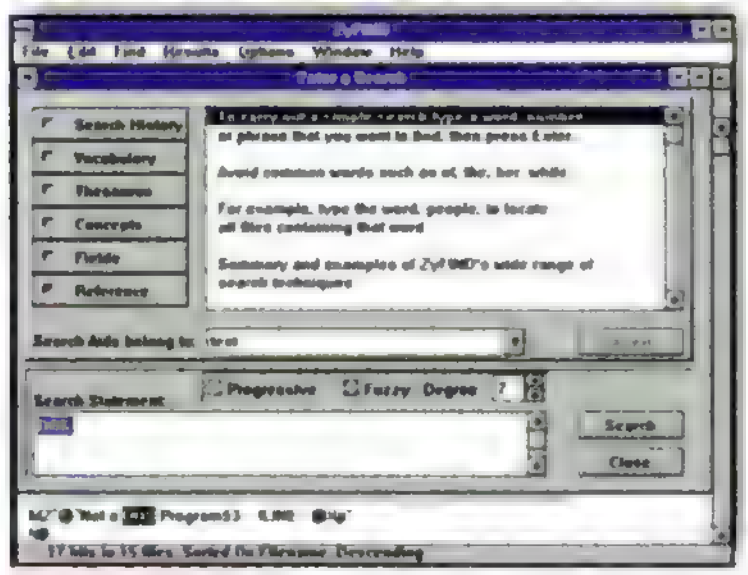
During our evaluation with a 90-MHz Pentium testbed, Isys was the speed king, indexing our 10MB test group of 315 assorted files in 2 minutes, compared with 3 minutes 30 seconds for ZyIndex. Both products indexed flawlessly as a background task, although indexing speed and the speed of foreground tasks slowed noticeably. You can schedule regular intervals for automatic reindexing, such as every half hour or once a day. You must, however, load the indexing modules before automatic indexing can occur.

While fast with raw data files, we found that Isys was especially slow at indexing files located on drives compressed with Stacker 4.0, taking hours to complete the index. The only way to stop the indexing process was to reboot the system. ZyIndex, on the other hand, took about 6 minutes to index the same test group of files on a compressed drive.

Unlike other text-indexing programs, ZyIndex and Isys have relatively modest storage requirements for file indexes. Isys was somewhat more efficient than ZyIndex, requiring 2.2MB to store index files for our 10MB group of test files; ZyIndex's index files required 3.4MB.

Isys's and ZyIndex's search modules are more user friendly than their indexing modules. Both have similar capabilities, starting with the basic ability to frame searches with Boolean logic by using the AND, OR, and NOT operators. The programs can also create proximity searches—which find search terms within a specified distance from other terms—and can conduct secondary searches that look only for information within the set of already-found documents.

Both programs let you save search parameters for later use, and you can also develop search synonyms, in which searching for one term finds all synonymous terms. Each of the document management programs allows for two increasingly popular advanced search methods. First, fuzzy searches help where the programs look for partial matches even if the word is misspelled. Second, you can search within text fields. For example, a text field could contain all information between the word name and the beginning of the next paragraph.



SORT OF, KIND OF: *ZyIndex can search for topics based on fuzzy logic parameters.*

POWER SEARCH

Overall, we found that of the two packages, ZyIndex has slightly more searching power. Both programs can look for numbers within ranges, but ZyIndex also can conduct more open-ended numeric searches such as finding documents containing number ranges. ZyIndex was able to search a group of scientific papers for numbers greater than 300, for instance. Also, ZyIndex supports so-called quorum searches that find all documents with two or more words from a group.

Both programs completed simple searches almost instantaneously, although they took a second or two to perform complex and numeric searches. Isys and ZyIndex can display search results in several formats, such as by listing the file names or showing the first lines of found documents.

Both of these products can launch the located documents in their native applications, or you can use each program's built-in viewers. The Isys package has a distinct advantage here, since its viewers can include the text-formatting from the source documents. Each of the products supports hyperlinking between documents, and you can embed audio objects in ZyIndex documents that have already been retrieved; Isys, however, does not support this feature.

"TELL ME..."

While ZyIndex has slightly greater searching power, Isys's search environment is friendlier and supports plain English queries. In Isys, we entered the search "tell me about modems and sound cards," and the program returned documents that mentioned both parameters. Isys also has a search dialog box with large, well-marked buttons on which you can click to add Boolean expressions, while ZyIndex makes you type search commands, which requires a greater mastery of the intricacies of Boolean operators. Another welcome Isys touch is macros for launching searches from within popular word processors.

Because they can make sense out of masses of seemingly unrelated information, text-retrieval tools like Isys and ZyIndex are welcome additions to the tool chests of information professionals.

Isys for Windows 4.0. *List price: $435; upgrade, $99. Requires: 8MB RAM, 4MB hard disk space, Microsoft Windows 3.1 or later. Isys Odyssey Development Inc., Englewood, CO; 303-689-9998; 800-992-4797; fax, 303-689-9997.*

Circle 402 on reader service card

ZyIndex for Windows 5.2. *List price: $395; upgrade, $99. Requires: 8MB RAM, 10MB hard disk space, Microsoft Windows 3.1 or later. ZyLAB, a division of ZyCo International, Gaithersburg, MD; 301-590-2760; 800-544-6339; fax, 301-590-0903.*

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CONTACT MANAGEMENT

TeleMagic: Group Contact Management with a Few Quirks

By Theresa W. Carey

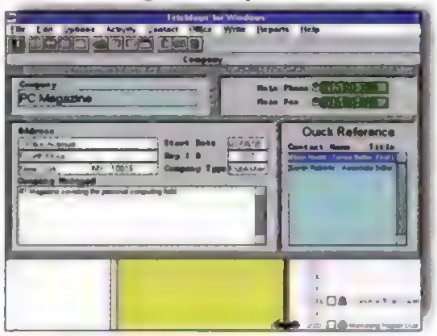
It's flexible, it's customizable, and it can pull everyone in your company together. It can also be slow switching from one task to another, and its calendar occasionally gets off-kilter. But for the price (single user, $500; five-user network, $1,300), TeleMagic is hard to beat.

TeleMagic was one of the first high-powered contact-management programs to run under DOS, and its Windows implementation is very effective. It includes the usual features you'd expect in a contact manager: databases for keeping track of people and companies, a calendar, and a to-do list.

The Windows version includes internal e-mail, "quick reports" on the currently displayed record, activity purge and archive, and improved links to external word processors. The relational database model used by TeleMagic makes it easy to link a record in the contact management file to your to-do list, and to create reports showing tasks by priority level.

Where TeleMagic shines, though, is in its customizability. Each database can store up to 252 fields, with up to three levels of detail. You can use the built-in Screen Designer to display them on-screen for viewing or data entry. Within the Contact Manager, fields are linked to either a company, an individual contact, or a sales contact. TeleMagic ships with a disk full of templates that you can adapt for your company's use—or you can start from scratch and set up your own.

Are you on the road often? In that case, TeleMagic's database synchronization will come in handy. This feature allows you to merge two separate databases.



KEEPING APPOINTMENTS: *Despite its quirkiness, TeleMagic is a powerful contact manager.*

We found that synchronization works only when the database structures are identical, though. The synchronization process lets you choose which records will be exported, so the database you want to travel with will include only those to-do items that are of personal importance.

TeleMagic's calendar displays activities by day, week, or month. You can schedule activities from within the Contact Manager, which avoids one problem area we found during our testing: The calendar does not always open to the date where you left off.

Version 1.5 is an improvement over the first release and shows that TeleMagic is moving in the right direction. It's worth checking out if you're looking for a flexible and customizable contact manager for a group.

TeleMagic. *List price: Single user, $500; 5-user network, $1,300. Requires: 8MB RAM, 12MB hard disk space, Microsoft Windows 3.1 or later. TeleMagic Inc., Dallas, TX; 800-835-6244, 214-733-4292; fax 214-733-4251.*

Circle 419 on reader service card

CD-ROM SOFTWARE

Managing Your Money Plus Bulks Up, But Still Lags Behind Quicken

By Gregg Keizer

If there's a personal finance program with a chance of staying in the ring with Intuit's Quicken—the personal finance heavyweight champ—it's MECA Software's $39.95 Managing Your Money Plus. This CD-ROM combines Managing Your Money for Windows 2.0 with several important updates, audio advice by guru Andrew Tobias, and a library of personal finance literature. Even with all these extras, however, Managing Your Money Plus is still an underdog.

LISTEN TO AN EXPERT: *Managing Your Money Plus provides advice from Andrew Tobias.*

Managing Your Money (MYM) handles the basics of personal finance with aplomb. You can write and print checks from an on-screen checkbook, categorize expenses, reconcile accounts, track a budget, and produce detailed reports.

MYM can "drill down" from a report directly to the transaction, and its Financial Snapshot—though no match for the similar feature in Quicken—shows net worth, budget, account totals, and estimated taxes.

Tax-planning and investment management remain this program's strengths. You can update the integrated 1040 form and Schedules A through F from its database and play out "what-if" scenarios. Investors will appreciate MYM's solid portfolio manager—which handles such sophisticated activities as puts and calls—and will welcome the alerts that appear when a stock's price reaches a specified high- or low-point.

Managing Your Money Plus puts a veneer of reference and multimedia extras atop this software. Andrew Tobias speaks on 45 topics—from saving for retirement to evaluating life insurance needs—with an occasional visual aid. Many of his discussions, however, are similar to those already embedded as text within MYM. A large collection of personal finance articles is also included.

For all these improvements, MYM lags behind Quicken in several important areas. Scheduling future transactions is more troublesome, reports provide fewer customizing capabilities, and both the program's set-up process and documentation are second-rate in comparison. Managing Your Money Plus still lacks the overall integration and superb ease-of-use that Quicken (whether on a floppy disk or a CD-ROM) demonstrates.

Managing Your Money is still in the fight, but it's definitely behind on points.

Managing Your Money Plus. *List price: $39.95. Requires: 6MB RAM, 14MB hard disk space, Microsoft Windows 3.1 or later; 8-bit audio card, double-speed CD-ROM drive. MECA Software Inc., Fairfield, CT; 800-537-9993, 203-255-1441.*

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FIRST LOOKS PLUS

From June 26 through 30, you can go on-line to discuss electronic banking and MECA Software's Managing Your Money Plus with Bart Barker (VP, Advanced Technologies) and Jennifer Miller (director, Electronic Services), hosted by reviewer Gregg Keizer. Type GO EXEC from any CompuServe ! prompt.

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Inverted Back

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Back

1. Follow instructions on the other side

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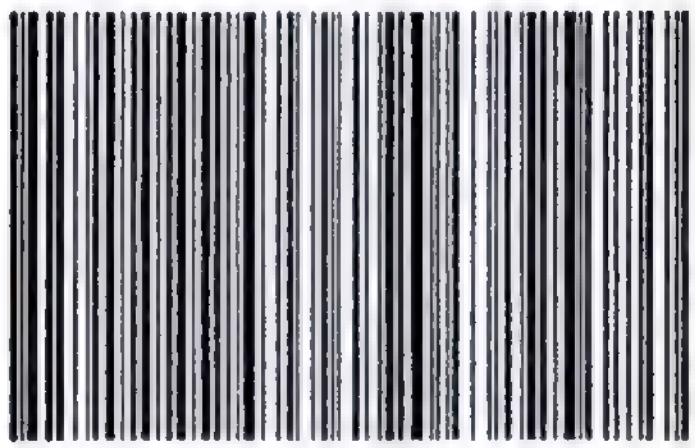

Foldout slip-sheet

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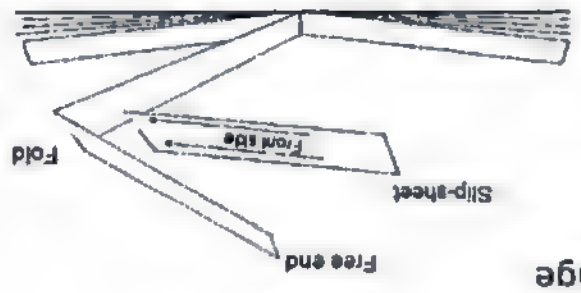
2. Insert this sheet with
1. Front side touching the free page
2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



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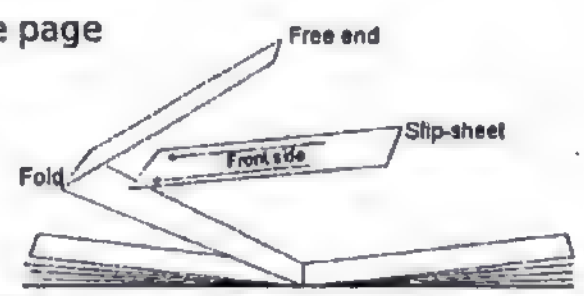

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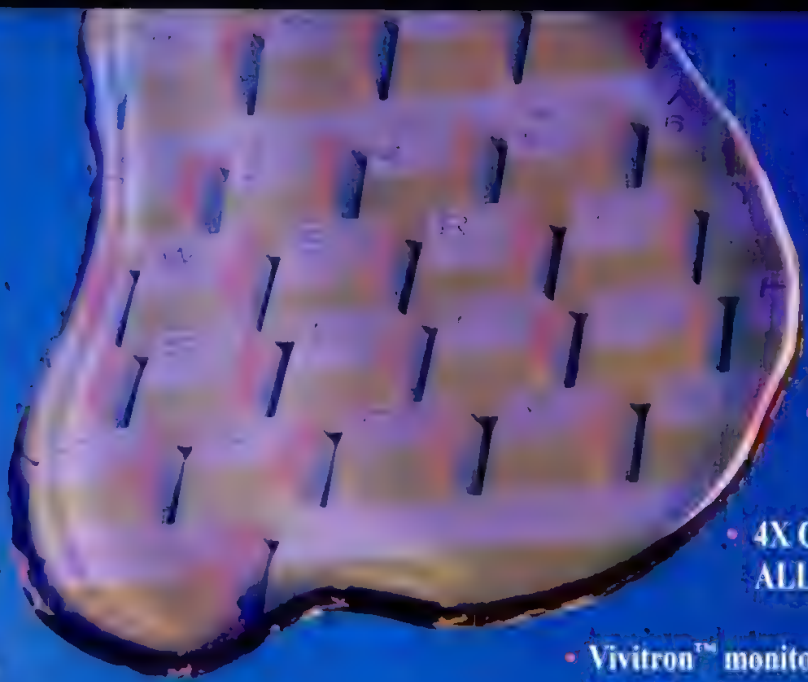

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- TelePath IIv 14.4K Fax Modem Communication Center
- 3.5" Diskette Drive
- 15" CrystalScan Color Monitor
- 7-Bay Desktop Case
- 101-Key Keyboard & MS Mouse 2.0
- MS-DOS 6.22 & WFW 3.11
- Generations Software Collection†
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- PCI Enhanced IDE Interface
- 64-Bit PCI Graphics Accelerator w/ 2MB DRAM
- 4X CD-ROM, 16-Bit Sound Card & Altec ACS-5 Speakers
- TelePath IIv 14.4K Fax Modem Communication Center
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- TelePath IIv 14.4K Fax/Modem Communication Center
- 3.5" Diskette Drive
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- 4X CD-ROM
- 3.5" Diskette Drive
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- MS-DOS 6.22 & WFW 3.11
- MS Office Professional 4.3** Bookshelf and Money 3.0
- 3-Year Limited Parts Warranty

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- 256KB Pipelined Burst Cache
- 1GB 10ms IDE Hard Drive
- PCI Enhanced IDE Interface
- 64-Bit PCI Graphics Accelerator w/ 2MB DRAM
- 4X CD-ROM
- 3.5" Diskette Drive
- 15" Vivitron Color Monitor
- 7-Bay Desktop Case
- AnyKey Keyboard & MS Mouse 2.0
- MS-DOS 6.22 & WFW 3.11
- MS Office Professional 4.3** Bookshelf and Money 3.0
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P5-120XL

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- 16MB EDO Performance-Enhanced Memory
- 256KB Pipelined Burst Cache
- 1.62GB 9ms IDE Hard Drive w/ Mode 4 Support
- PCI Enhanced IDE Interface
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DATA STORAGE

Is Iomega's Zip Tomorrow's Floppy Disk Drive?

By Winn L. Rosch

If Iomega's Zip drive takes off, it could mean saying goodbye to your trusty 3.5-inch 1.44MB floppy disk drive. The $199 Zip drive is easy to connect, fairly fast at reading and writing data, and its Zip disks can hold up to 96MB of data. Even if your knowledge of interfaces and software drivers is limited, you can have a Zip drive up and running in a matter of minutes.

The Zip drive has the potential to be the high-capacity floppy disk drive for the next generation of computing. Zip technology is a close match in terms of price, capacity, and performance to today's inexpensive QIC-80 tape drives. Zip drives cost a little more and each Zip disk holds a little less data than the 120MB capacity of standard QIC-80 tape drives, but Zip's speed and easy setup more than compensates for the difference.

THREE-WAY STREET

The major Zip applications include backup, primary storage for large files such as graphics or multimedia, and use as a portable data-transport system. The problem is that Zip's access time of 35 milliseconds—about twice as slow as Iomega's own Bernoulli systems and SyQuest cartridge disks—is too slow for use as a primary drive. And, like a notebook's hard disk, the Zip drive powers down after prolonged inactivity, adding a couple of extra seconds of delay. During testing, we often found ourselves waiting for data to start flowing from the Zip drive.

Available in both parallel port or SCSI interfaces, all current Zip drives install externally and are packaged in a stylish cobalt-blue plastic case, which measures 1.5 by 5.3 by 7.2 inches (HWD). Soft rubber feet on the side and bottom allow the system to sit horizontally or vertically. The complete unit is compact and weighs less than a pound, but lacks the rugged, solid feel of Iomega's Bernoulli products. The Zip drive has one operating control—a button that ejects disks after a brief spindown delay. You can also eject a disk through software.

NEO-BERNOULLI: *Iomega's Zip drive uses cartridges that can hold nearly 100MB of data.*

Initial setup was quick and easy. The parallel version requires little more than plugging it in. The system works with all parallel ports up to the EPP (enhanced parallel port) standard. A second jack on the back of the drive lets you plug your printer into the Zip drive and use both through one PC parallel port without shuffling cables.

The configuration of the SCSI-2 Zip drive was a bit more involved, but nonetheless hassle-free. On the back of the drive you'll find two Apple-style 25-pin connectors and two setup switches. One switch turns the SCSI termination off and on, the other selects a SCSI ID of 5 or 6 (no other choices are available). If you don't have a SCSI host adapter, Iomega offers a high-performance host adapter called Zip Zoom for $49.95.

The drive effectively mixes flying head technology from Winchester-type hard disk drives with Iomega's experience with flexible disks. The drive contains a 32K buffer and the disk spins at 2,968 rpm, which limits the system's internal data-transfer rate to 1.3 megabytes per second. With a conventional parallel-port-equipped PC, we measured actual throughput of 83K per second (or 5MB per minute), which is noticeably better than many QIC-80 tape drives that rely on the floppy disk controller. SCSI throughput was closer to 15MB per minute.

While the actual disk inside the cartridge measures 3.5 inches across, the cartridge itself is a bit bigger: 0.25 by 4.0 by 4.0 inches (HWD). This is slightly larger than a conventional 3.5-inch floppy disk or 3.5-inch magneto-optical cartridge. For this reason alone, Zip products are not compatible with conventional floppy disks or Floptical drives.

Each drive includes a Zip disk containing a selection of utilities, including Disk Tool (a utility for managing your drive), Copy Machine (a program for duplicating disks), Catalog (a program to track your Zip cartridges), Move (a tool for moving applications from your hard drive to Zip disks), and Zip Tour (a familiarization program).

An interesting piece of software designed especially for occasional use is called Guest. The program matches the drive to DOS, reports its drive letter assignment, and facilitates file transfer, but disappears without a trace when you reboot. Zip uses the backup utility included with DOS 6.0, and provides an icon to launch it through Windows. OS/2 support is offered as an option.

PICK A PLATFORM

The SCSI Zip drives work with both PCs and Macintoshes, and the disks are compatible with both platforms. Whether the 96MB Zip disk replaces the 1.44MB floppy as the standard for software distribution and data exchange remains to be seen. Zip is competitive in terms of per-megabyte storage costs and capacity with Sony's MiniDisc, SyQuest's 3.5-inch cartridge, and 3.5-inch magneto-optical drives. Iomega's $199 Zip also surpasses each of these alternatives in terms of up-front drive price.

The remaining question is which interface to choose. While SCSI Zip is faster, the parallel port version can be plugged into any PC, desktop or portable.

ZIP IT UP: *Zip utilities show disk details, as well as simplify backup and duplication chores.*

Zip drive. *Estimated street price: $199; 96MB cartridge, $19.95. Requires: DOS 4.0, Microsoft Windows 3.1 or later. Iomega Corp., Roy, UT; 800-697-7833; 801-778-1000.*

Circle 421 on reader service card

FIRST LOOKS PLUS

From June 19 through 23, you can go on-line to discuss Iomega's Zip drive with product manager Andy Grolnick and *PC Magazine* contributing editor Winn L. Rosch. Type GO EXEC at any CompuServe ! prompt.

TAPE BACKUP

Datasonix's Pereos Puts a World of Data in the Palm of Your Hand

By Winn L. Rosch

James Bond would be jealous. With Datasonix's Pereos tape drive, you can carry more than a gigabyte of your favorite data—clandestine or otherwise—in your pocket. But while the drive and cassettes in this $749 tape system are the smallest around, you're likely to find that you'll have to spend some time waiting for the system to read your data.

The tiny cassettes are hardly larger than a stack of postage stamps, measuring just 0.2 by 0.9 by 1.2 inches (HWD). Each $34.95 tape can hold 1.25 gigabytes of compressed data. This is roughly equal to 900 floppy disks or the contents of one of today's hard disk drives. The Pereos drive is similarly minuscule, measuring 4 by 2.4 by 1.9 inches.

THREE IN ONE

As you would expect from something you can hold in one hand with three fingers left over, the Pereos has been designed with portability in mind. A three-part system, the Pereos consists of the drive proper, a base unit that links to your PC, and an included 7-watt external transformer. Alternatively, you can use a pair of AA batteries to power the drive and leave the transformer behind. With batteries, the Pereos weighs in at 10 ounces.

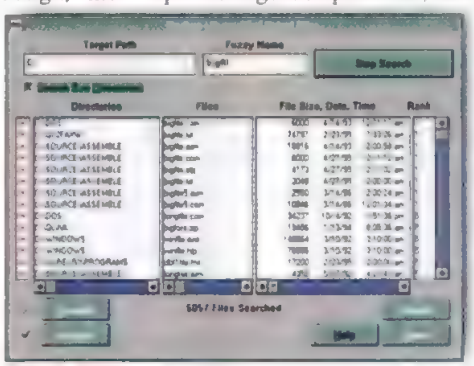
Datasonix estimates battery life at four months, and clearly they expect you to back up as often as most people do—which means almost never. In practical use, the batteries gave about 5 hours of backup time, which amounts to just enough time to fill one or two tapes.

All the connections for data and power are made through the base, so you can conveniently pull out the drive and take it with you; Datasonix sells additional bases for $179.95 each. The Pereos system requires no hardware installation other than plugging it into your PC's parallel port. The Pereos's parallel cable is permanently attached to the base, but at 18 inches long, it may prove to be a bit too short for some systems. The cable includes a pass-through device so you can still use the parallel port for a printer.

According to Datasonix, you can expect throughput of about 10MB per minute using built-in data compression. In testing with a standard bidirectional parallel connection, the Pereos system achieved throughput of 5MB per minute and 10MB per minute for uncompressed and compressed data flows, respectively.

The Pereos's portability and data density can also help you squeeze more space out of your notebook's cramped hard disk by temporarily offloading files to tape; the product includes a useful file synchronization utility that expedites the process. In addition, Pereos cassettes are the ultimate data exchange medium—you could overnight a couple dozen of them in an ordinary envelope. Of course, the recipient must have a Pereos drive with which to read the tapes.

Although Pereos is a homegrown Datasonix design, the hardware originated with Sony's NT-1 Digital Micro Recorder, which is sold abroad as the Scoopman. Datasonix adapted the technology by adding an extra head, start/stop abilities, and software. Sony manufacturers the drives and tapes.



PEREOS KNOWS: *Fuzzy searches let you look for files even if you can't remember exact names.*

The Pereos uses a helical scan system borrowed from VCR technology to move huge amounts of data to and from the tapes. The system uses a spinning drum head that rotates at 3,000 rpm to write to tapes that crawl past the head at one-quarter-inch per second. But rather than the drive physically pulling the tape around the head—as VCRs do—the Pereos presses the drum head into the tape to establish and maintain contact. Each cartridge holds 80 feet (24.8 meters) of tape measuring 0.1-inch (2.5-mm) wide.

To assure data integrity without having to read the data twice, the four magnetic heads work sequentially during the write process to achieve true read-after-write technology. The way it works is that the heads scan the tape with a read head immediately after each write operation to verify what's on the tape. During read operations, the four heads scan the tape in quadruplicate, pulling data from multiple adjacent tracks at once. The driver sorts and organizes the data.

HANDY DATA: *Pereos can pack more than a gigabyte of information onto a tiny cassette.*

BACK UP ANYWHERE

Datasonix supplies a Windows-based backup and data management system with the Pereos. Besides the expected backup features—full and selective backups, restoration, and tape utilities—the Pereos software includes fuzzy logic searches (to help find a file if you can't remember a file's full name), tape management (so you know what you have on the tape), and a history feature (which keeps track of every file change that has been made).

Of course, small size has its drawbacks. Pereos cassettes are almost too small to label and too easy to lose. We also found that it can take about 2 minutes for the system to find the spot on the tape where the selected data resides, which is about twice the wait you have with DAT tapes. At about a nickel per megabyte, however, the price of storing data on Pereos is less expensive than both bulkier tape technologies and lower-capacity flash memory or hard disk PCMCIA cards.

Because of its compact form and parallel-port connection, the Pereos makes a near perfect portable tape backup system. You can back up with battery power at 40,000 feet, and you can pack the drive in your briefcase along with your PC and flip-phone and still have room for several secret agent toys.

Pereos. *List price: $795; tape, $34.95; additional base unit, $179.95. Requires: 8MB RAM, 8MB hard disk space, DOS 5.0 or later, Microsoft Windows 3.1 or later. Datasonix Corp., Boulder, CO; 800-328-2779, 303-545-9500; fax, 303-545-9249.*

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MULTIFUNCTION PRINTERS

Canon MultiPASS 1000: Six-Pack for the Office

By Bruce Brown

Canon's MultiPASS 1000 Document Processing System could easily be called a six-pack for the variety of devices it squeezes into a compact unit. With an estimated street price of $800, the MultiPASS combines a 360-dot-per-inch monochrome ink jet printer engine, a plain-paper fax, a PC fax, a scanner, a copier, and a telephone. While the price is right for the small-office market, the biggest compromise is the lack of gray-scale printing.

You won't have to yield much desk space to the MultiPASS 1000's 17.3-inch-wide by 13-inch-deep footprint, and the 15.4-pound unit is only 7 inches tall. Legal- or letter-size paper fits in the system's 200-sheet capacity cassette, which slides into the front of the unit. The included automatic document feeder can shuffle up to 30 pages into the MultiPASS for faxing, scanning, or copying.

HYDRAMATIC: *The Canon MultiPASS 1000 combines six of the most commonly used office machines into one unit.*

You don't even have to turn on your computer to use the MultiPASS 1000 as a copier, fax machine, or phone. When you do run your computer, Canon's MultiPASS passes information back and forth through the PC's bidirectional parallel port. This provides a simple and tidy one-cable connection to your PC, rather than requiring a parallel connection for printing and a serial link for scanning, as the Xerox line of multifunction devices does.

BACKGROUND OPERATION

The system's Desktop Manager for Windows 1.0 software runs in the background to effectively manage the PC fax, scanning, and telephone functions such as auto-dialing; the system maintains separate inbox, outbox, and fax logs. You can create phone books for faxing to individuals and groups and for telephone auto-dialing within the MultiPASS Desktop Manager. Incoming call signals can be set for automatic fax or voice discrimination, and the system supports distinctive ring detection if you have different numbers on the same line for voice and fax calls.

The MultiPASS 1000 uses the Canon BJ200 monochrome Bubble Jet print engine, which relies on 64 ink nozzles. A Windows driver is included with the Canon MultiPASS Desktop Manager, but if you want to print from DOS applications, the printer can emulate the Canon BJ200/10e, IBM Proprinter X24E, or Epson LQ510. Standard Canon BX-2 black-ink cartridges are rated at 1,400 text pages.

In testing, the system yielded print speeds of 76.7 characters per second in text printing and 1.8 graphics pages per minute. These are respectable—though not outstanding—scores for mainstream ink jet printers, and the printed text quality is a whisper shy of laser printers, with very little fuzziness on plain paper and some banding in black areas. Graphics are rendered clearly, but as single-bit images without the subtleties of gray-scale printing.

When you fax directly from the Canon, you can use on-hook dialing and fax-page memory storage that can hold the contents of 70 received fax pages or 50 pages ready for transmission at a later time. You can set the software to automatically print all incoming faxes, hold them in memory, or store them on your PC's disk; to print faxes in the Canon's memory you press two buttons on the relatively simple control panel. The two-line LCD panel makes operation easy.

Faxing from the PC is accomplished via the DeskTop Manager, which includes a fax viewer with zoom and rotation features and custom cover sheets. There's a setting that will automatically reduce incoming faxes on legal-size paper to fit on letter-sized paper.

FAST FAXING

In fax testing, it took 1 minute 49 seconds to transmit a complex test image in fine mode. The same image faxed back to the Canon took the plain-paper fax machine 2 minutes 52 seconds to process.

As with printing, the Achilles' heel of the MultiPASS is that you can't scan in gray-scale mode. The MultiPASS 1000 supports 1-bit line art scanning at 200 dpi, so the unit's utility in scanning photographs is severely limited. For typical text and business graphics scanning this machine should be more than sufficient, but if you send a lot of graphics by phone, look elsewhere.

A Windows Twain driver is provided so you can access the Canon via standard Windows image and optical character recognition scanning applications. For easy scanning via the DeskTop Manager, you click on either an icon or a menu selection and the MultiPASS 1000 scans images that you can view, print, and save.

Last, but not least in importance, the MultiPASS 1000 is a good, basic convenience copier. It can produce up to 99 copies per page, but there is no collating feature and neither reduction nor enlargement. Once again, the lack of gray-scale support means that copied photo graphs or gray-scale images will be all black and white, similar to the reproductions produced by personal copiers.

BAND ON THE RUN: *The ink jet print engine on the MultiPASS 1000 produces single-bit images with some visible banding in dark areas.*

The Canon MultiPASS 1000 is the first in a family of multifunction devices from Canon's Home Office Products Division that is likely to grow to include color and gray-scale scanning technologies. The current model is competitively priced and quite easy to use, if limited by its lack of gray-scale abilities.

Canon MultiPASS 1000. *Estimated street price: $800. Requires: 4MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later. Canon U.S.A. Inc., Home Office Products Division, Lake Success, NY; 800-432-1467, 516-488-6700.*

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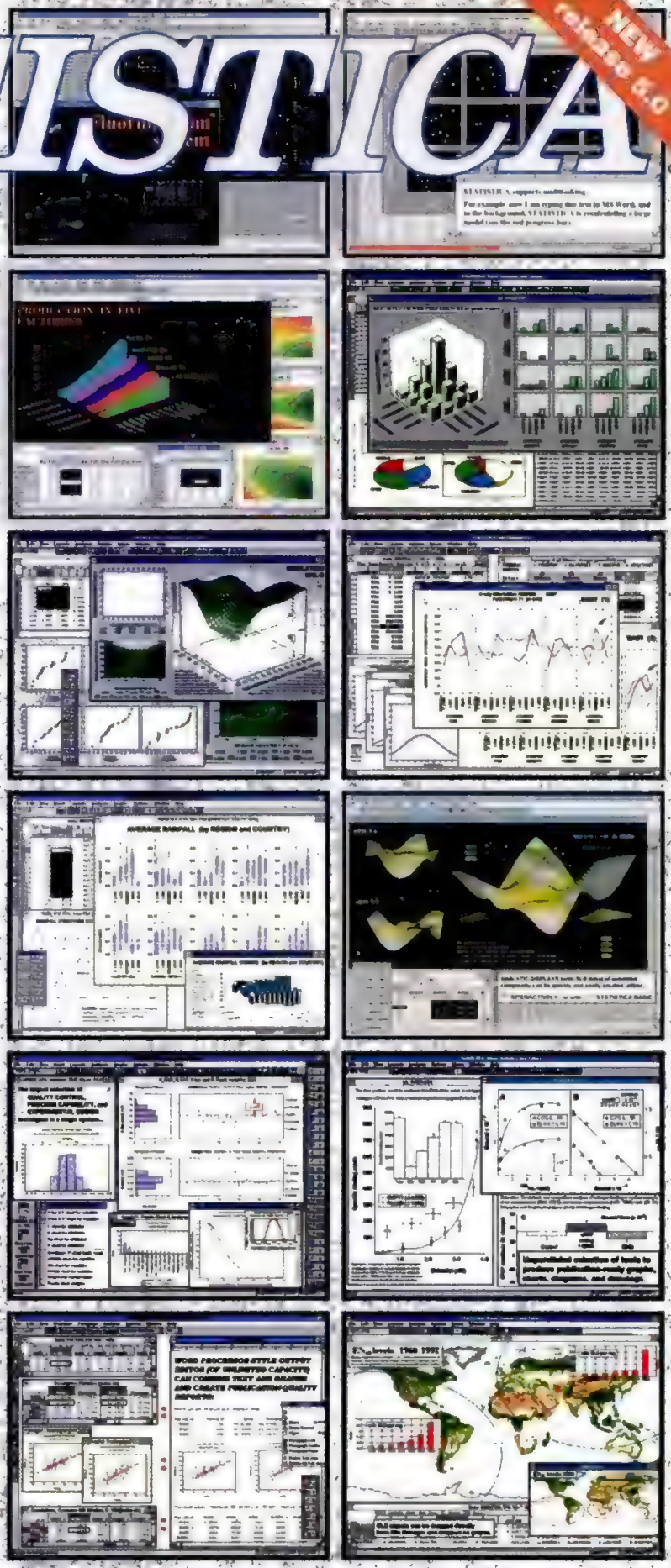

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BUSINESS CD-ROMS

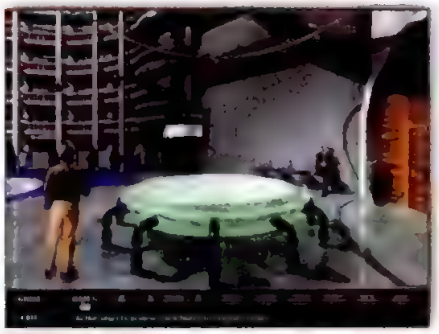
Presentation World Brings Corporate Training to the PC's Small Screen

By Neil J. Rubenking

The comparison is inescapable: Cinemar Corp.'s Presentation World could do for presentation software what MYST did for games. Designed for both neophytes and seasoned veterans, Presentation World is a virtual conference that delivers the benefits of a live training seminar to your office.

The Virtual Conference Center (VCC) includes a keynote speech, three seminars, two exhibit halls, and an interactive infrastructure that's both attractive and engaging. The lesson plan consists of presentation content, media acquisition, presentation assembly, presentation delivery, and media management.

The content, assembly, and delivery portions feature virtual presenters who use multimedia visual aids and who speak in front of photorealistic backgrounds. If you drift off during a lesson, fear not: You can pause, rewind, and fast-forward the seminars, and detailed notes are available at the click of a button. Interactive exhibits in the two exhibit halls demonstrate topics in media acquisition and management.



VIRTUALLY ALONE: *The Virtual Conference Center is a realistic learning environment.*

Navigating within the VCC is a breeze; zip directly to a particular location by clicking on the map in your virtual conference guide. The guide contains a wealth of information, including outlines, lists of the exhibits, a glossary, and an index.

The first in a series of CD-ROM conferences, Presentation World's realistic, interactive environment is sometimes more interesting than the content of a real seminar.

Presentation World. *Estimated street price: $195. Requires: 8MB RAM, 1MB hard disk space, Microsoft Windows 3.1 or later. Cinemar Corp., Beaverton, OR; 503-646-2800; fax, 503-626-8439.*

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INPUT DEVICES

DrawingSlate II Makes Sketching Easy

By Winn L. Rosch

When you need to place a hundred points, draw freehand, or trace a blueprint, you'll need a digitizing tablet with pinpoint accuracy and the feel of paper. CalComp's electromagnetic DrawingSlate II comes in three sizes, with active drawing areas of 6 by 9, 12 by 12, and 12 by 18 inches. The 6- by 9-inch tablet's overall measurement is 10.1 by 11.2 inches, but it is just 0.3-inch thick and weighs 1 pound 8 ounces. The DrawingSlate features resolution of up to 2,540 dots per inch and 0.01-inch accuracy.

You can select from among two thick cordless pens (one pressure-sensitive, one not), and a 4-button or 16-button cordless mouse. In contrast to other tablets that use nonpowered pens, these styli use two watch batteries and have space for two spares.

LIGHT TOUCH: *DrawingSlate II is pressure sensitive.*

DrawingSlate includes drivers to link with your applications: AutoCAD, mouse emulation under DOS, and Windows through the WinTAB standard. Also included is a Windows-based Tablet Manager that lets you calibrate 256 levels of pen pressure, assign macros to 18 tablet hotspots, and allocate specific tablet areas to individual applications. The tablet includes a transparent textured-plastic sheet to secure drawings you want to trace.

Versatile, flat, and compact, the DrawingSlate II makes sketching on your PC almost as easy as picking up pen and paper.

DrawingSlate II. *List price: 6- by 9-inch tablet, $280; 12- by 12-inch tablet, $280; 12- by 18-inch tablet, $425. Requires: 640K RAM, Microsoft Windows 3.1 or later, serial port. CalComp Digitizer Division, Scottsdale, AZ; 800-932- 1212, 714-821-2000; fax, 714-821-2832.*

Circle 417 on reader service card

WINDOWS SOFTWARE

Flash Forward Pro: Keyboard Shorthand for the 90s

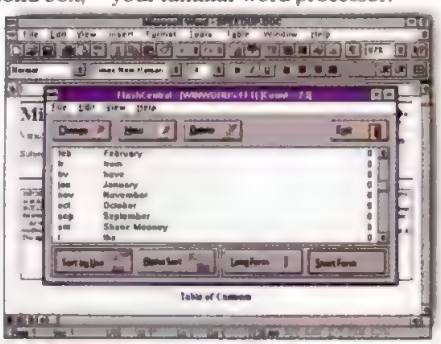
By Shane Mooney

Do you find that while typing, your fingers can't keep up with your thoughts? The $99.95 Flash Forward Professional helps you type a little faster by substituting an intuitive shorthand for frequently used words, phrases, and names.

A memory-resident program, Flash Forward supports Windows versions of Microsoft Word, WordPerfect, Ami Pro, Microsoft Write, and Microsoft Notepad, and loads with the word processor. You can type an abbreviation of commonly used words and Flash Forward automatically spells out the full word or phrase. For example, when we typed *jan,* Flash Forward expanded it to January; enter *sy* and the program types Sincerely Yours. Flash Forward comes with 12 starter abbreviations. You can also add your own: Go to the Create New Abbreviations screen, enter the abbreviation in the first dialog box and the full word or phrase in the second box, and you're ready to start using your new keyboard macro.

Flash Forward will remind you when you could have used an abbreviation, and keeps track of words that are good candidates for keyboard abbreviation. We found that the program also selects the correct ending for abbreviated words automatically by pluralizing the word or adding an *ing* ending. And you can add custom endings such as *ology* easily.

Once we got used to the program, Flash Forward's built-in abbreviations speeded up our typing by about 25 percent. Forget about learning old-fashioned shorthand; here the speed of shorthand is coupled with the convenience of your familiar word processor.



IN A FLASH: *Flash Forward Professional keeps track of frequently used words.*

Flash Forward Professional. *List price: $99.95. Requires: 4MB RAM, Microsoft Windows 3.1 or later. Summit Software, Fremont, CA; 800-577-6665, 510-770-3495; fax, 510-656-4644.*

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Powerhouse performance with exceptional portability

HP OmniBook 600

- 3.8 pounds; 7.3" x 11.1" x 1.6"
- 75MHz IntelDX4™, 50MHz IntelDX2™ processors
- 8.5" DSTN VGA with 256 colors; simultaneous SVGA-out supports up to 1024 x 768 x 256 colors
- Accelerated local-bus video
- Full-sized, 85-key touch-typeable keyboard; built-in, pop-up mouse
- Typical battery life 3.5 hours (*PC Magazine* run down test 2.46 hours**)
- 260MB or 170MB rugged, removable PCMCIA hard drive
- 4/8MB standard RAM, expandable to 12/16MB
- Two PCMCIA Type II slots (or one PCMCIA Type III)
- External floppy drive comes standard
- Built-in I/O (serial, parallel, infrared, VGA out)
- Optional enhanced port replicator that adds SCSI-2 and HP LAN card slot
- Instant on/off; hot keys for faster application access
- EPA Energy Star certified
- Three-year limited warranty, first-year overnight Express Exchange

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- Optional enhanced port replicator adds SCSI-2, PCMCIA slots, and MIDI/joystick port
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†In Canada, call 1-800-387-3867. *Average U.S. street price. **PC Magazine Labs Winbrain, 1995. MS-DOS is a U.S. registered trademark and Windows is a U.S. trademark of Microsoft Corporation. The Intel Inside logo is a U.S. registered trademark of Intel Corporation. ©1995 Hewlett Packard Company. PP6415

intel inside

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- Local bus Enhanced-IDE hard disk interface
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- 1MB of video RAM standard
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- Full plug-and-play capability
- Complete Windows 95 compatibility
- Preloaded Desktop Management Interface (DMI)
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We believe this commitment helped us to be ranked highest in customer satisfaction among desktop PC business users by J.D. Power and Associates.[1] And made us the fastest-growing desktop PC brand for business in 1994. For more information or the name of your nearest HP dealer, call us at 1-800-322-HPPC, Ext. 9385.[2] Encouraging comparison really works for us.

users and based on 1,[illegible] user respondents. [illegible] Other capacities available. All HP Vectra PCs come with MS DOS® 6.2 and MS Windows for Workgroups 3.11 pre-installed. HP mouse and keyboard. First year on-site, 24-hour service. [illegible] trademarks of Intel Corporation. [illegible] Hewlett-Packard Company. PP9-17

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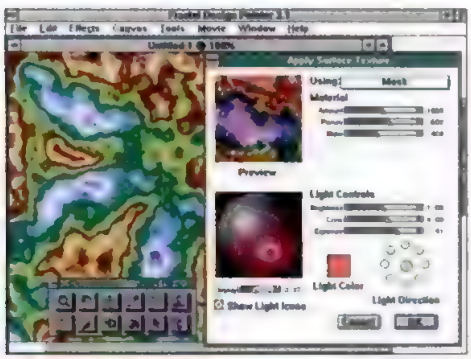
New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Asa Somers

Big Features for Free

Registered users of Fractal Design Painter 3 can now download the upgrade to Version 3.1 for free from AOL or CompuServe. What was initially intended as an incremental upgrade boasts some powerful features, most importantly a new 32-level Undo feature. **Fractal Design Corp.** has also added a Gradation Editor for designing more sophisticated "algorithmic" gradations, a Fill dialog box that gives users more control over a fill's attributes, and new, sensitive texture controls. Added support for .GIF files should please aspiring Internet authors.



SENSITIVITY TRAINING: *Painter 3.1 features more sophisticated texture controls.*

Meanwhile, Fractal Design Corp. has been moonlighting with Artbeats Software to develop the first in a series of CD-ROMs called The Sensational Surfaces, which lists for $79.95. The five-disk library contains 100 natural textures.

Fractal Design Painter, Version 3.1. *List price: $499; upgrade from Version 1.x and 2.0, $149. Fractal Design Corp., Aptos, CA; 800-297-2665, 408-688-8800; fax, 408-688-8836.*

Circle 406 on reader service card

This Board Does Both

The miroConnect 34 wave, from **miro Computer Products,** is a V.34-compatible 16-bit ISA board designed for desktop conferencing, supporting simultaneous data and voice communications over a single phone line. Its IBM Mwave MDSP2780 DSP processes multiple tasks, allowing you to talk to someone using an external microphone and co-edit a single document at the same time. The miroConnect comes with its own Web browser and supports 32-voice wavetable audio.

miroConnect 34 wave. *List price: $349. miro Computer Products Inc., Palo Alto, CA; 800-249-6476.*

Circle 407 on reader service card

HOT PROSPECT

Receive a Color Image on a Monochrome Fax Machine

Developed exclusively for **Infoimaging Technologies** by its Israel-based sister company Fontech, 3D Fax uses compression and encoding technologies to condense up to 40K of data onto a single fax sheet. Additional security features let you "password-protect" incoming faxes.

It all starts with an electronic file—say, a color image of a train—that 3D Fax converts into code that can be sent directly to a standard fax machine. The fax machine prints what looks to the human eye like complete jibberish—but wait! Scan that sheet into your PC, and 3D Fax takes over. The software reads and decompresses the encoded data and the 5:15 arrives in full color.

The *infoimaging* technology behind 3D Fax compresses the data, allowing you to send large files directly to a modem in a fraction of the time. 3D Fax automatically recognizes the format of the transmitted file, restoring it to its original format and opening it in the appropriate application.

Infoimaging is now distributing a limited freeware version of 3D Fax; you pay only $6.95 for shipping or download it for free from the Internet. 3D Fax Standard provides transmission savings of 65 to 70 percent, and also offers a "send-twice" mode for reliable transmissions to noisy fax environments. The Professional version of the software supports password security for faxes, color-optimization features, and additional fast transmission rates.

3D Fax Standard. *List price: $99.* **3D Fax Professional.** *List price: $199. Infoimaging Technologies Inc., Palo Alto, CA; 800-966-1140; e-mail, info@infoimaging.com*

Circle 405 on reader service card

Follow That Form

By the time you read this, **Novell** will have begun shipping Version 4.1 of its InForms package, which is designed for professional forms-creation and -distribution uses. The new version features cross-application macro support for automating repetitive tasks and 58 new formulas for improving workflow, data-processing, and database-interaction capabilities. When you send a form via a MAPI-based e-mail system, InForms attaches a custom form rather than the standard message-with-attachment icon. Double-clicking the icon launches the form.

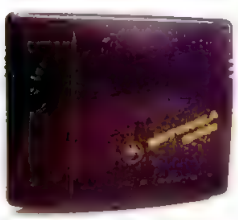
InForms will also update your linked databases automatically when forms are sent via your e-mail system. Use the Designer version of the product for forms creation and the Filler for completing an existing form. The Filler is an OLE 2.0 server, which allows you to add forms to third-party documents. InForms reads from and writes to Lotus Notes. Registered users can upgrade to Version 4.1 for $199 for the Designer and Filler package or $99 for the Filler alone.

InForms, Version 4.1. *List price: Designer and Filler package, $495; Filler, $199; additional Filler licenses, $99. Novell Inc., Provo, UT; 800-861-2507.*

Circle 408 on reader service card

Motorola's BitSurfr: Catch the ISDN Wave

Billed as "the first terminal adapter for the retail market," the new BitSurfr TA210 Digital Modem from **Motorola** is designed for use over ISDN lines. The sleek modem, which retails for $495, measures 2 by 5 by 5 inches (HWD) and connects to the serial port on your computer, delivering data-transfer rates of 64 Kbps over ISDN lines. Although your current communications software will work with the BitSurfr over digital lines, the modem comes bundled with HyperAcess software and a built-in NT1 feature, which lets you connect directly to an ISDN line.



SURF 'N' TURF: *The BitSurfr brings ISDN to the masses.*

BitSurfr TA210 Digital Modem. *List price: $495. Motorola, Huntsville, AL; 800-451-2369.*

Circle 409 on reader service card

Photography by Thom O'Connor

Okidata Expands SOHO Printer Market

Okidata will soon be shipping three new printers aimed at SOHO and medium-size business users: the OkiJet 2010 color ink jet printer and the OL810e and OL1200 laser printers. The 9.8-pound OkiJet 2010 produces 600- by 300-dpi full-color prints on plain or coated paper, transparencies, envelopes, index cards, and labels. It has a built-in 150-sheet feeder and uses a single snap-in black-ink cartridge and a single color cartridge; the printer is rated at about 1,000 black prints and 200 color prints on a single set of cartridges.

The OL810e laser printer produces 8 pages per minute at 600- by 1,200-dpi resolution. It comes with 2MB of RAM (expandable to 32MB), a 250-sheet universal paper input tray, and 45 resident scalable fonts, including 10 TrueType fonts. It can print up to 2,000 pages on a single toner cartridge.

SLIMLINE COLOR: *The OkiJet 2010 weighs 9.8 pounds and does 600- by 300-dpi color.*

The higher-end OL1200 laser printer is networkable via an internal high-speed port and optional NICs. It offers 12-ppm print speeds and 600- by 600-dpi resolution, and comes with 2MB of RAM (upgradable to 34MB). The OL1200 comes standard with a 500-sheet input tray and a 5,000-sheet toner cartridge.

OkiJet 2010. *List price: $499.* ***OL810e.*** *List price: $999.* ***OL1200.*** *List price: $1,499. Okidata, Mount Laurel, NJ; 800-654-3282; fax, 609-778-4184.*
Circle 410 on reader service card

What's In a Name? Portable Documents

No Hands Software has changed its name to that of its flagship product—a portable-documents application, now in Version 2.0—calling itself **Common Ground Software**. With the help of TrueDoc, licensed from Bitstream, Common Ground 2.0 now preserves the look of all fonts at any resolution. It supports on-the-fly anti-aliasing for improved on-screen readability and includes PostScript support. A new Split View feature lets you view a Common Ground document and a navigation window simultaneously, while Version 2.0 incorporates Verity's search technology, which lets you do Boolean searches, among others. You can attach electronic "sticky notes" to documents and electronically "staple" two Common Ground documents together; you can even prevent someone else from opening or changing a Common Ground file via new password and DES encryption support.

Common Ground, Version 2.0. *List price: Includes the Common Ground Maker and two Viewers, $189. Common Ground Software, Belmont, CA; 800-598-3821, 415-802-5800.*
Circle 411 on reader service card

HARDWARE BRIEFS

Hewlett-Packard Co. has introduced its SOHO all-in-one device, called the HP OfficeJet LX. The ink jet model prints at 600- by 300-dpi resolution, producing 3 pages per minute. You can now fax directly from the desktop, although the unit only supports 9,600-bps modem speeds. The OfficeJet holds up to 24 pages of faxes in memory, supports Twain-compatible scanning, and has a front-loading, 100-page paper tray that holds letter-, legal-, and A4-size sheets. 800-474-6638.

On the heels of HP's introduction of the LaserJet 5P, the first mainstream printer with infrared capabilities, **Extended Systems** announces the $179 JetEye ESI-9580A adapter. Attaching to any printer's parallel port, the JetEye provides cordless printing from any IrDA-compatible PC or notebook. 800-235-7576.

Independent CD-ROM developers take note: **Pioneer New Media Technologies** has announced the Pioneer DW-S114X, a desktop quad-speed CD-ROM recorder and reader that will provide a maximum transfer rate of 614 KBps. Scheduled to ship later this year, the $3,995 unit will include a 1MB data buffer and a SCSI-2 interface. 800-444-6784.

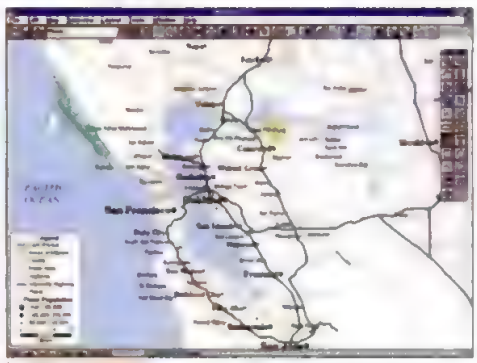
Do video captures from a television program or watch your favorite shows on your computer screen with the new $249 Reveal TV500 card, from **Reveal Computer Products.** You can capture closed-caption displays and save them as text files. The card comes with all the necessary cables and software, supports a display of 1,024-by-768, and offers a 12-channel simultaneous preview mode. Capture in 24-bit color with the card's freeze-frame support. 800-326-2222.

Designed for use in the home and starting at a list price of only $1,800, the new one-piece TMP9000 line of PCs from **Tatung Company of America** incorporates either a 14- or 15-inch monitor into a single case with a 486 or Pentium CPU, 8MB of RAM, a 540MB hard disk, a dual- or quad-speed CD-ROM drive, a 14.4-Kbps modem, and integrated stereo speakers. 800-829-2850.

Syquest Technology has announced the EZ135 Drive, a removable cartridge storage unit that is expected to sell for under $200. Positioned as a SOHO backup storage solution, the EZ135 uses 135MB cartridges and features a 13.5-ms access time and a sustained data-transfer rate of up to 2.4 MBps. Cartridges will sell for under $30 each. 510-226-4000.

Maptitude: Maps and a Whole Lotta Data

The single best thing about **Caliper Corp.**'s Maptitude 3.0 desktop mapping and GIS system is that its competitive $395 list price includes a wealth of data on two CD-ROMs, comprising maps of all streets in the U.S., ZIP codes, counties, demographics statistics, street addresses,



I LEFT MY HEART . . . : *Maptitude includes demographic information for the whole United States.*

and Census Bureau TIGER files. Don't be fooled by the version number; this is an entirely new software package that is OLE 2.0–compatible—allowing you to drag and drop maps into other documents—and that uses ODBC to create virtual data tables from multiple databases. Maptitude 3.0 contains its own macro language, TrueType font symbol libraries, Active Topology map editing, and LAN support. Caliper expects to ship a Global Positioning System (GPS) add-on module sometime later this year.

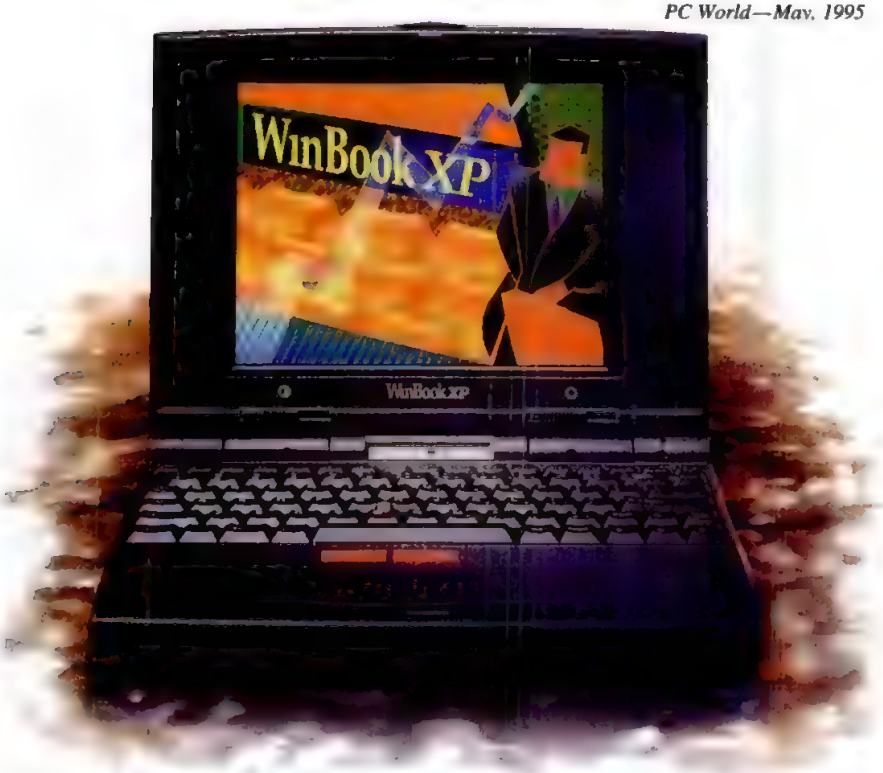
Maptitude 3.0. *List price: $395. Caliper Corp., Newton, MA; 617-527-4700; fax, 617-527-5113; e-mail, info@caliper.com.*
Circle 412 on reader service card

NEW & IMPROVED PLUS

You can download a demo version of Maptitude 3.0 from Library 4 of the Editorial forum on ZiffNet. Type GO EDITOR from any CompuServe ! prompt.

"...the new top dog..."

PC World—May, 1995



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OCR Eyes the Bottom Line

Offering single-click optical character resolution (OCR), **Ligature**'s low-end CharacterEyes, Release 2.5, will let you scan from within your Windows-based word processor. The Twain-compliant, 32-bit application incorporates HP's AccuPage technology for scanning from colored backgrounds and recognizing small typefaces. While Ligature claims a 99.7 percent accuracy level and 300-character-per-second recognition speed, CharacterEyes requires only 3MB of free space on your hard disk and 4MB of RAM. Best of all, with a $30 company rebate, you will pay only $49.95.

A QUICK READ: *Ligature claims a 300-cps scanning speed for CharacterEyes.*

Ligature is also now shipping the $495 CharacterEyes Pro for higher-end OCR applications. It adds deskewing features, batch-processing capabilities, and the ability to read all western European character sets, as well as a trainable mode for teaching the software how to read obscure typefaces.

CharacterEyes, Release 2.5. *List price: With $30 company rebate, $49.95. Ligature Inc., Burlington, MA; 800-444-6433, 617-238-6734; fax, 617-272-3085.*

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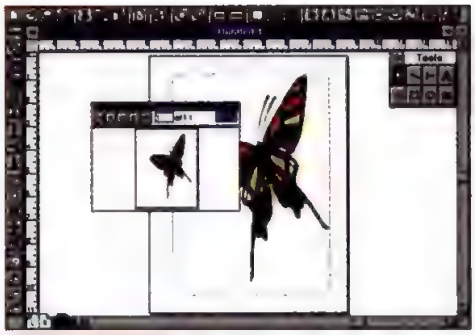
PageTools Gives You a Hand with PageMaker

PageTools, from **Extensis Corp.**, is a bundle of ten add-on utilities designed exclusively for use with Adobe PageMaker 5.0 for Windows. Intended to help mainstream users increase their productivity and efficiency, PageTools is centered around the PageBar, a customizable toolbar with buttons that provide one-click access to over 300 of PageMaker's functions and to those of PageTools itself. Page-Align automatically aligns objects without using guides or rulers, PageColors is a search-and-replace function for changing the colors of objects, and PageThumb displays thumbnail images. You can resize multiple objects and assign PageBar buttons to macros you create with PageScripts. Adobe is offering 220 free fonts and, until June 30, a free copy of PageTools with the purchase of PageMaker 5.0.



BUNCH O' BUTTONS: *The PageBar gives you one-click access to PageMaker's features.*

PageTools. *List price: $129. Extensis Corp., Portland, OR; 800-796-9798; fax, 503-274-0530; e-mail, extensis@aol.com.*

Circle 414 on reader service card

SOFTWARE BRIEFS

Triton Technologies is shipping Version 2.0 of its remote communications program CoSession for Windows ($99). You can operate a second, remote PC from your host system via modem, serial port, or network connection. The latest version automatically configures both the host and remote PCs, supports simultaneous remote connections, has improved security features, and comes with a new uninstall program. Version 2.0 supports connections across NetWare and NetBIOS networks. 800-322-9440.

When computer files become fragmented (stored in pieces after repeated use), access time lengthens. Diskeeper for Windows NT is a utility from **Executive Software** that uses its three-pass Performance-Guard mechanism to clean up your hard disk space and defragment files. The program works even when files are open, using idle resources that do not impact system performance. You'll pay $199 retail for a workstation copy and $399 for a server copy. 800-829-6468.

Scientific Endeavors Corp. has begun shipping GraphiC, Version 7.0, a platform-independent C library that enables users to write scientific graphing programs for producing high-quality technical graphics. The latest version ($495) includes a number of new plots, better printer flexibility, new panel-clipping techniques, and support for higher-resolution GraphiC metafiles. 800-998-1571.

Developers can create optical character recognition (OCR) applications with **Maxsoft-Ocron**'s Recore, Version 4.0. Based on the company's MORE engine, the $2,495 Recore uses four technologies to accomplish its OCR: feature-extraction, structural-analysis, matrix-matching, and neural-network. Version 4.0 is 50 percent more accurate than its predecessor and features a modular command library, intelligent page segmentation, automatic deskew features, and a maximum recognition speed of 250 characters per second. 800-933-1399.

Desktop publishing prices hit new lows with **Expert Software**'s $14.95 Power Publisher for Windows. Designed for the entry-level user, Power Publisher still provides text-wrap, rotation, and 400 percent zoom features, as well as support for OLE. Master Pages let you repeat objects and styles, and a convenient AutoSave feature makes sure you don't lose important work. 800-759-2562.

The Hydra Comes Home

Defining a new segment in the SOHO market, **Lexmark International** is now shipping its new multifunction "hydra" product, the Medley. This 17-pound color printer-fax-scanner delivers 300-dpi resolution and produces 3 pages per minute in monochrome and a single 16-million-color page in 2.5 to 7 minutes. As a fax machine, the Medley supports 14.4-Kbps transmissions, holds up to 60 fax pages in memory, and can broadcast a transmission to up to 50 locations at once. The Twain-compliant Medley scans only in monochrome, supports 300-dpi resolution and 256 levels of gray scale, has a 150-sheet paper capacity, and prints on envelopes, transparencies, and card stock. Lexmark's three different Medley models—the 4c, 4x, and 4sx—differ only slightly, both in functionality and in price.

COLOR MEDLEY: *Lexmark's multifunction device prints in 16 million colors.*

Lexmark Medley. *Estimated street price: $849 to $899, depending on configuration. Lexmark International, Greenwich, CT; 800-358-5835.*

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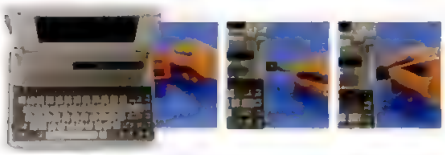

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Our 28,800 bps speed means more productivity for users and less time on phone lines. Which means less money tied up in data transmission. And because it is based on the ratified V.34 standard, you can be assured of the most reliable connections possible.

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Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

For Pen PC Mogul, a Sword Would Have Been Mightier

BY DON WILLMOTT

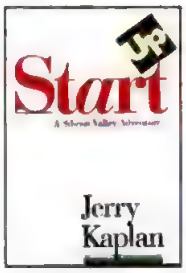
Remember three years ago, when pen-based computing was poised to become The Next Big Thing? It never happened, and no one is more painfully aware of that than Jerry Kaplan, who founded GO Corp. to bring pen PCs to the masses.

If you're going to fail big at something, you might as well have fun in the process, and Kaplan certainly did. *Startup,* his account of the rise and fall of GO and its innovative pen-based operating system called Penpoint (a product that never even really went on sale), is an entertaining and fast-paced Silicon Valley roller coaster ride.

Starting with little more than ambition and a pat on the back from computing visionary Mitch Kapor, Kaplan had big successes as he was getting started in 1987 and 1988. He scored plenty of venture capital and prominent potential customers. Things were looking good, and then Microsoft came to visit.

Kaplan acknowledges that many forces combined to bring GO down, but he saves special scorn for Bill Gates and the pen-computing team at Microsoft, which he suggests stole his ideas and rushed to get them into a new version of Windows so that software developers wouldn't be attracted to the new Penpoint OS. While Microsoft contended that the familiar and widely accepted Windows interface could be adapted for pen use, Kaplan argued vehemently that pen computing required Penpoint's new notebook-type paradigm. But he soon found that neither hardware nor software developers had the courage to venture far from Microsoft's camp.

From 1990 through 1993, Kaplan endured endless rounds of demo shoot-outs, money-raising, and deal-making with IBM, and later with AT&T, which eventually merged GO into its own EO division only to kill the whole thing off in mid-1994.



"Venture capitalists are masters of procrastination. Their standard practice is to keep all options open until the last possible moment, often abandoning some hapless entrepreneur at the altar after months of reassurances that there is just one final question to answer before they will invest."
—Jerry Kaplan

Kaplan himself points out that "the real question is not why the project died, but rather why it survived as long as it did with no meaningful sales." His answer: "[It's] a testament to the force of will and the compelling power of belief in an idea." Not to mention the $75 million he spent on his excellent adventure.

Startup, *by Jerry Kaplan, $22.95. Houghton Mifflin, 800-225-3362; ISBN: 0-395-71133-9.*

Circle 533 on reader service card

Law and Order on the Wild, Wild Net

BY MELISSA J. PERENSON

Life on the Internet has been likened to that of the Wild West. Instead, as Lance Rose shows us in *Netlaw: Your Rights in the Online World,* the Internet and commercial on-line services are really more akin to developing countries where existing laws must be adapted and new legislation created for an ever-evolving society.

As *Netlaw* shows, the process of making the law is a slow one that has yet to catch up with the technology that's the de facto governor of the Internet. Instead, much of the litigation involving the Net today is being based upon traditional legal thinking, pending the advent of new laws that take the Internet's unique social and business environments into account.

Netlaw offers an invaluable primer on the legal issues of being on-line, from the perspectives of both members and providers. The topics covered in *Netlaw* run the gamut from First Amendment guarantees to contract and commercial agreements, rights of privacy, and intellectual property issues.

Netlaw never presumes to be a do-it-yourself approach to legal issues on-line. The book does include many handy templates and some supplementary information that will enhance your understanding of the topic. One appendix details various relevant legislative measures that apply to on-line computer usage, including the entire 1988 Electronic Communications Privacy Act and excerpts from the 1991 Computer Fraud and Abuse Act, the Privacy Protection Act, the Child Pornography Statute, and the 1992 New York Computer Crime Statute.

Although *Netlaw* is not going to answer every question you may have about on-line legalities, it's a terrific starting point. And, as Rose maintains in his first chapter, "Everyone who works or plays in the online world should know his or her rights."

Netlaw: Your Rights in the Online World, *by Lance Rose, $19.95. Osborne McGraw Hill, 800-227-0900; ISBN: 0-07-882077-4.*

Circle 534 on reader service card

READ ONLY RECOMMENDS

If you're still planning to write communications software or maintain a bulletin-board service, even after Microsoft releases Windows 95, then plan to keep Tim Kientzle's *The Working Programmer's Guide to Serial Protocols* on your shelf. $39.95, Coriolis Group Books, 800-410-0192; ISBN: 1-883577-20-9.

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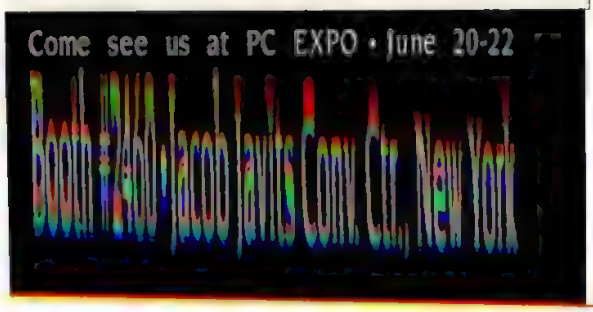

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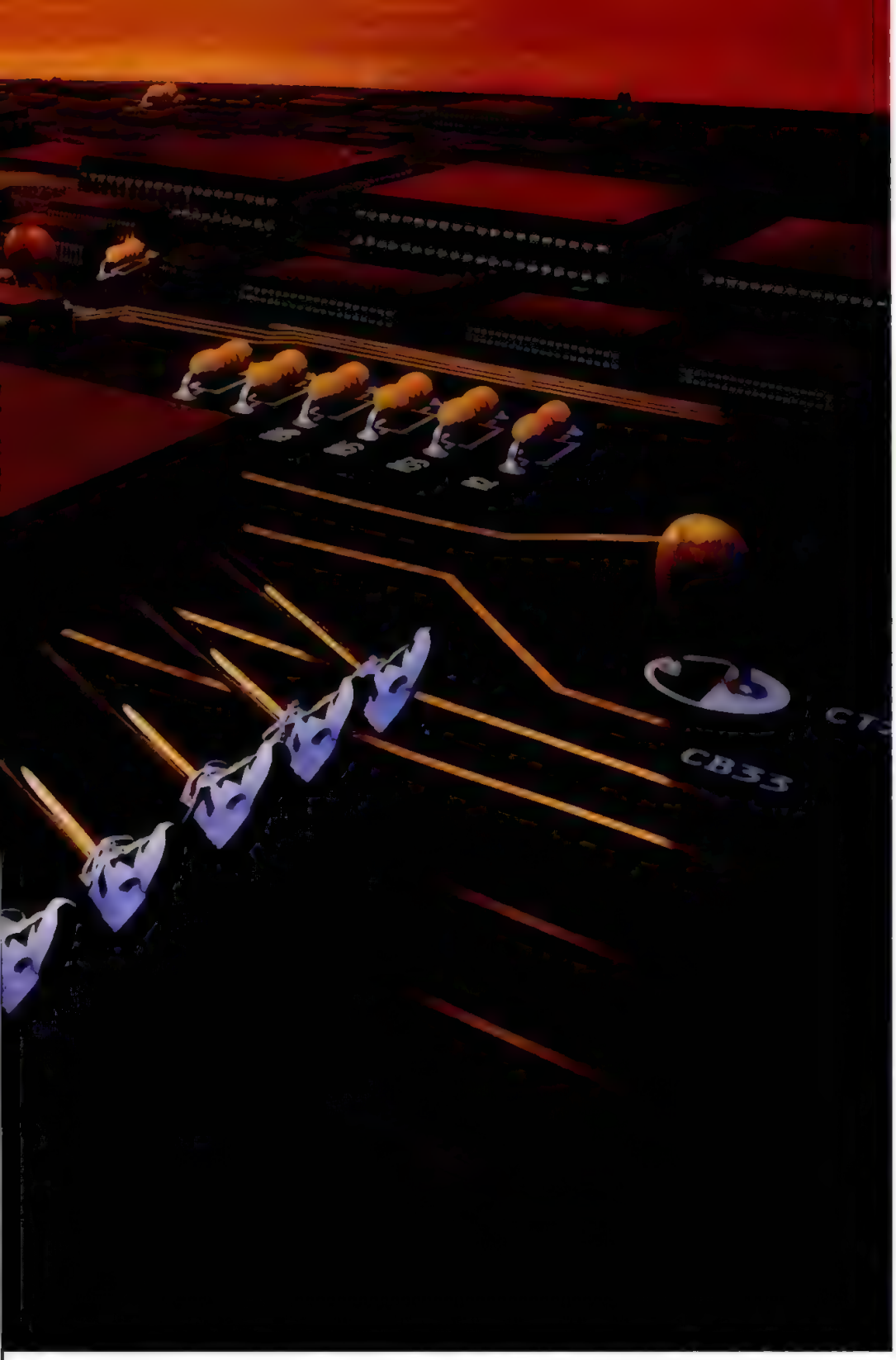
© 1995 Intel Corporation. *Source: iCOMP®: A Simplified Measure Of Relative Microprocessor Performance. Intel Corporation, 1992. ** The 63 MHz Pentium OverDrive processor for most 50 MHz and 25 MHz Intel486™ CPU-based systems is available now. The 83 MHz Pentium OverDrive processor for most 66 MHz and 33 MHz Intel486™ CPU-based systems will be available later in the year. ***Other trade names referenced are the property of their respective holders.



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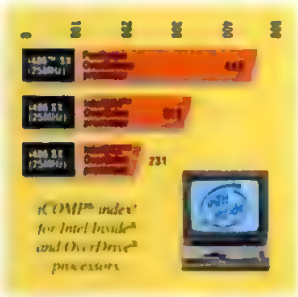
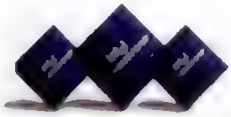


OverDrive processors boost CPU performance as much as 343%, making your software run much faster.



The family of IntelDX2™, IntelDX4™ and newly released Pentium® OverDrive processors†† gives you several affordable upgrade options for your i486™ CPU-based PC—each of them fully software compatible.

Contact your PC reseller for more information about OverDrive processors, or dial the FaxBack® service at 1-800-525-3019, document #9306. Or call 1-800-538-3373, ext. 295.

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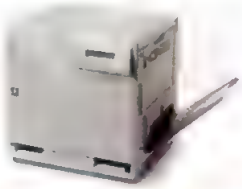

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Michael J. Miller

The Ubiquitous Network

Fill in the blanks: "The tremendous and rapid growth of the Internet is a_____(blessing/curse) that has _____(positively/negatively) affected my life." I'm sure we've all thought about how the Net has changed the way we work and—for some of us—play, but are we ready to accept its ramifications? In a corporate environment, the additional electronic traffic will make the jobs of network managers and corporate information officers more complicated, and some employees will waste more than a little time exploring the Web. But whether we like it or not, the Internet and global network connections are here to stay, with important implications for users, managers, and software developers.

ALL TOGETHER NOW

We've seen big growth in enterprise network solutions, where multiple locations within the same company are connected. New technologies, such as ATM, allow for a broader use of "virtual LANs," where ad hoc teams can be created and supported easily. New group software packages—from discussion databases and group editing tools to workflow solutions—are going to make group communications a more powerful and effective resource.

The next big wave in electronic communications will be connections among organizations that work together. With *outsourcing* and *strategic alliances* as the latest management buzzwords, expect to see the number of connections between companies increase. We're seeing a big push for mail gateways and electronic data interchanges. The development in size and capabilities of public data networks will help to accelerate this trend.

Once everything is connected, you'll be able to get to any data source from just about any other data source. The idea that you'll have separate information bases on the different services—such as America Online, CompuServe, Prodigy, and the Internet—is short-lived. Eventually you'll be able to get the data you want from any source, wherever you plug in. The traditional on-line services know this well; that's why they're falling over themselves to become Internet service providers.

Today, you pay a service provider a monthly and perhaps hourly fee, but most of the information you get is free. That will change in the new connected world. The cost of access will go down dramatically as the pipes get bigger and the cost of high-speed connections comes down. There will continue to be a lot of free information, but I expect that you'll see a larger and larger proportion of information that costs money. This won't necessarily be expensive, but it won't all be free.

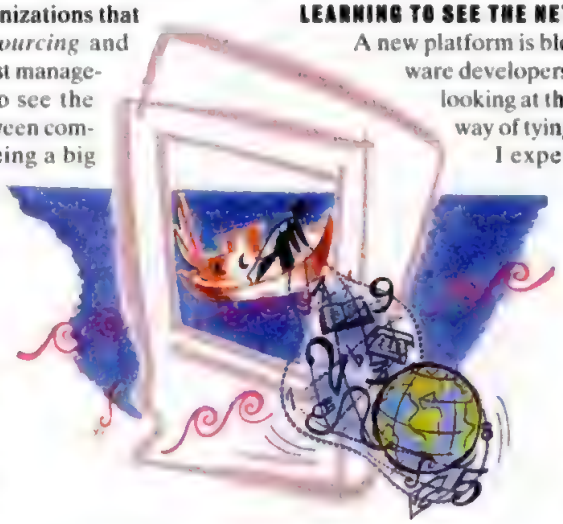
It's very much like today's cable television model, where we have "free" channels, some supported by the government, but most supported by advertising; premium services, typically supported by subscribers; and pay-per-view events. I expect you'll see all three types of offerings on the information appliance of the future.

LEARNING TO SEE THE NET AS A PLATFORM

A new platform is blossoming: the Internet. Software developers and users will have to begin looking at the Internet as more than just a way of tying together machines.

I expect that we will soon see all sorts of applications that take advantage of the Internet—everything from transaction processing to database access to a plethora of client-server applications. We're already seeing software standards set, with or without the cooperation of the traditional operating system companies.

These standards—governing everything from names and addresses on the Web to publishing and security—form a platform as surely as the APIs for



As global communications and on-line services grow, we'll begin to see the Internet in a whole new light.

Illustration by Steven Salerno

Windows, OS/2, and the Macintosh form platforms. For those waiting for a stronger alternative to Windows, the Internet may be a wish come true.

PCS DON'T BREAK THE LAWS; PEOPLE DO

Even if all computer networks connect with one another and all information is made available to everyone, we still won't have a network utopia. A whole new set of concerns about data access and data security arise, and they're worth worrying about. Data piracy will only grow as an issue, and we will have to learn to deal with it. The only real technological answer seems to be tighter access and better encryption.

Security systems and firewalls will become de rigueur, but they will have to improve. Consider SATAN (see Trends, June 13th, 1995), the network-security sniffer that caused such a controversy when its creator posted it on the Internet. Everyone is talking about new security standards for the Internet, with things such as public key encryption and password call-back systems. These are steps in the right direction, but electronic theft is something we as a society will have to learn to deal with.

Concerns about security will spawn better encryption methods. It's inevitable. And it is this inevitability that will doom the attempts by some of our lawmakers to censor information on the Internet. Censorship on the Internet can't work. With billions and billions of bits of encrypted information, how can it all be monitored? And who's going to say what should be censored, anyway?

Personally, obscenity doesn't bother me nearly as much as the potential threats to privacy and the broader distribution of information about weapons of mass destruction.

I do believe that we'll see a lot more self-censorship, be it from companies that want access limited only to places where they feel their employees can do work, or from service providers that want access limited only to material suitable for families. Neither of these types of systems will be foolproof, but it's probably a good thing that they'll exist.

On a more mundane level, think about network management. The companies that make hubs and routers think of network management as controlling the traffic on each segment of your network. The companies that make desktops think about managing the machines themselves, including hardware changes and configurations. Software companies are worried about making sure you have the right number of copies of software and that changes and updates happen properly. And the big network management vendors are worried about network changes, security, and trying to tie everything together.

It's all a house of cards, held together mostly by luck and hope. We need much more integrated, much more sophisticated suites of network management tools aimed at all levels, from the individual user to the workgroup manager to the network administrator to the member of the enterprise IS staff.

Thus, a new platform develops—one with an abundance of opportunities and challenges. I don't believe that government regulation or corporate reluctance can stop it. The Internet is here to stay, and love it or not, you'll have to learn to live with it. □

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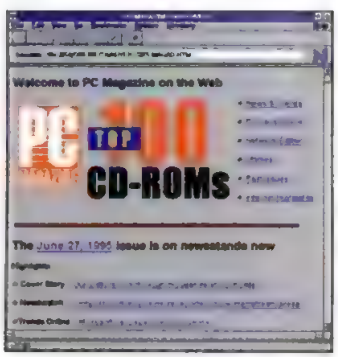

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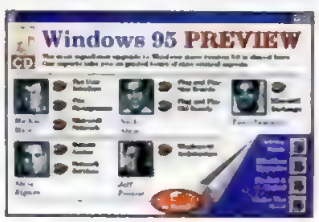

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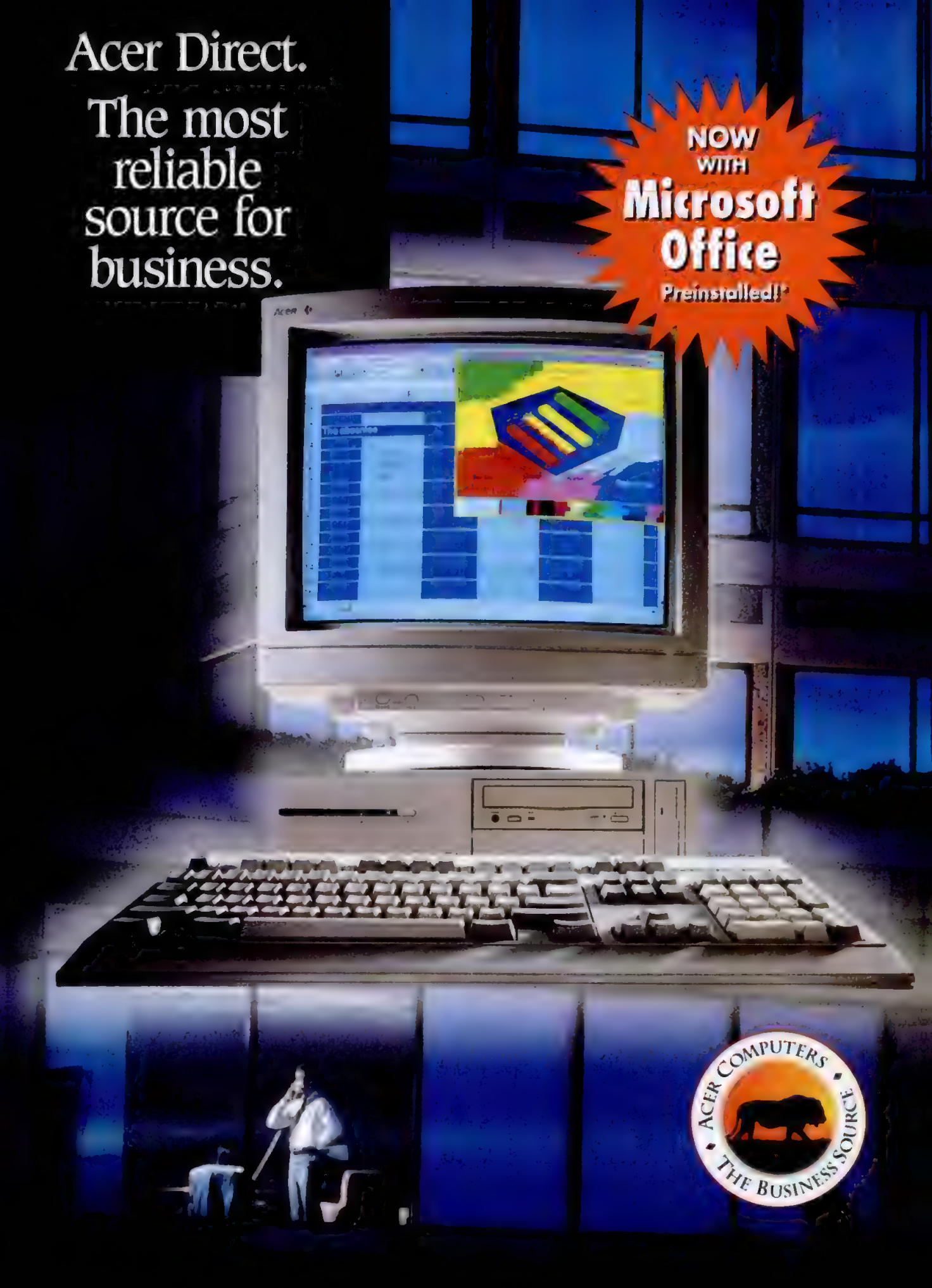
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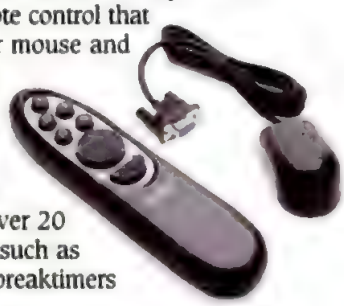

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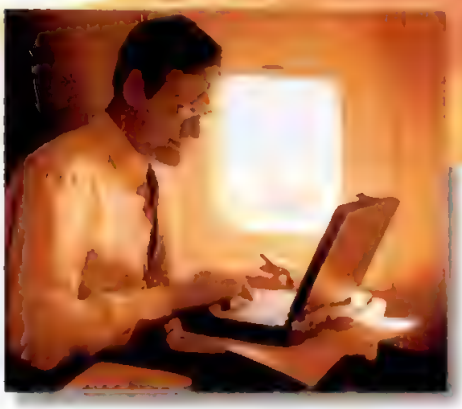

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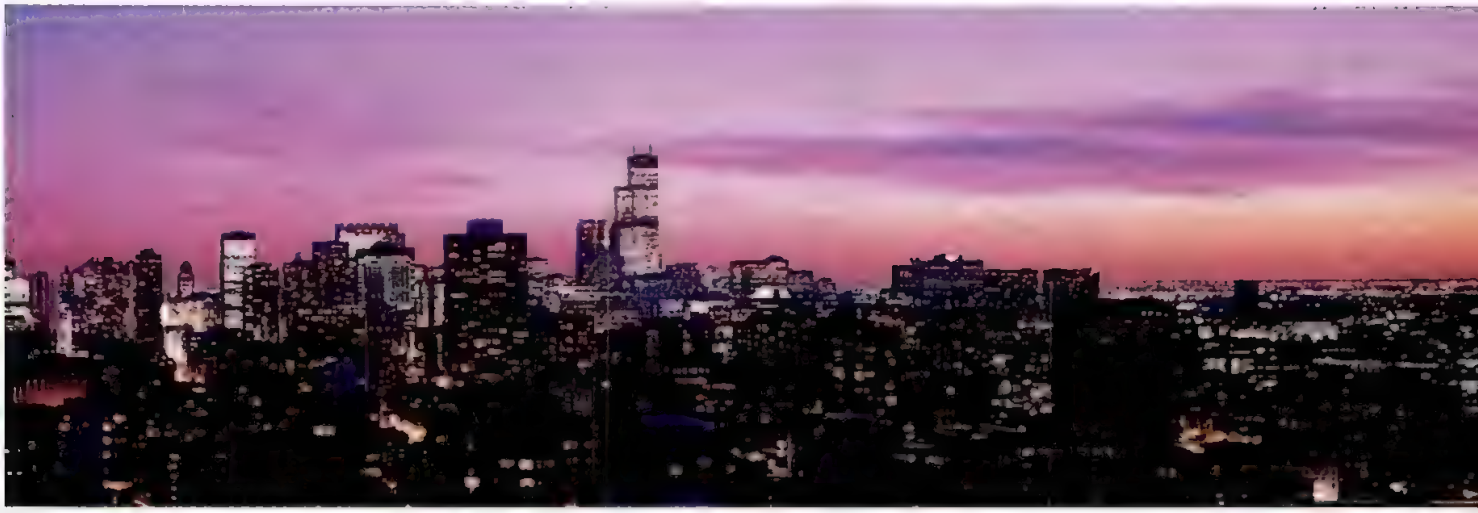

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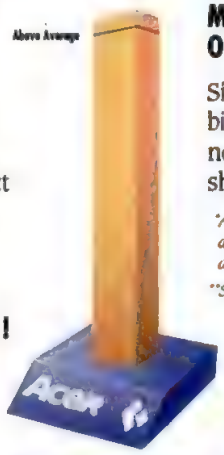

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Bill Machrone

I Know It's in Here Somewhere

I like to keep a low profile. I play acoustic guitar. If my car is fast, you'd never know it to look at it. I wear moccasins. My rule with notebook computers is the smaller, the better. Until recently, I carried a Gateway HandBook with an 80MB hard disk. The diminutive size and weight were far more important than what I could store on the disk. Even with that limited amount of storage, I had minimal but functional installs of Word and Excel; a couple of text word processors; and MailRoom for MCI Mail, WinCIM, Notes, and Inspiration—my favorite creativity software. I also had every word I'd written for the last five years. In this business, it's important not to repeat yourself; readers have long memories. Having all my words easily available is vital to keeping déjà vu from becoming real.

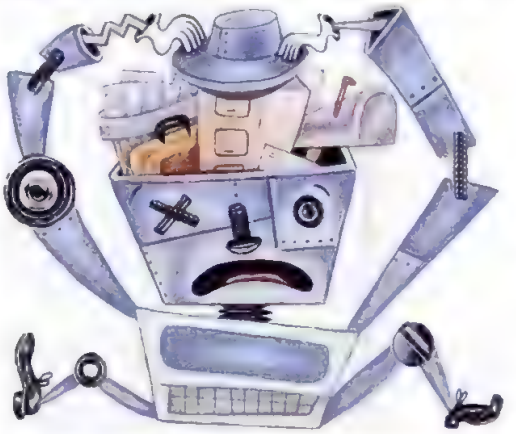
So when I traded up to a Gateway Liberty notebook, I chuckled to myself about the ridiculously large 540MB drive (although I was salivating for the 100-MHz DX4 and the big color screen), just as I did when I installed a home machine with a 1GB drive. Today, both machines have less than 100MB free. I've written before on code bloat (not to repeat myself, of course!), but that's not the culprit. In fact, there is no culprit, no diabolical plot to devour the world's supply of free disk space.

It comes down to the computer version of Parkinson's Law: The data expands to fill the space available. The more room you have, the more cool (or mundane) things you can do with it. In my case, a significant amount of the additional storage on the Liberty is taken up by correspondence—from you. I have thousands of letters regarding OS/2. Since I started the Second Looks column six issues ago, I've gotten hundreds of e-mails about products. I intend to keep them for a while, in case we get any "we don't have any dissatisfied customers" nonsense from the vendors. They also show the balance of those who are happy with their products and those with complaints.

I'm considering putting all the correspondence into an on-line text database. Hey, it's just a matter of disk storage, right? Some of the new text-search tools and abstracting software let you readily extract meaning from big collections of unindexed text. So you'd be able to ask a natural-language question such as "How does QuickBooks handle securities that have been sold?" and get the real-life experiences of our Second Looks correspondents. If you think this would be an interesting notion, send me mail (machrone@mcimail.com or 72241.15 on CompuServe). Fair warning: I haven't run this one past the lawyers yet.

I've also gotten four letters addressed to Second Looks. You know, the old-fashioned kind with the stamp and the envelope and all. Now let's err on the side of exhaustiveness and assume I want to get them into my database. Scanners and OCR software have been around for years, so it's no problem. But some of the scanner vendors would like to turn your PC into an electronic in-box for all your correspondence, including paper. In their scheme, you'd dump everything in uncritically, on the dual theory that you've got scads of disk space (I repeat, this is *not* a conspiracy) and that you can make better, faster decisions about the paper stuff on your computer than at your desk. You blow through the day's correspondence, deleting the unworthy and tabling the unlikely. At any point, you can OCR a document that needs editing or manipulation, or run it through a forms program that allows you to fill in the blanks and print out a completed facsimile of the original form. You can attach ASCIIed documents or scanned bitmaps and forward them to others.

Some people actually do this, and our own Jim Seymour has written about using Visioneer's PaperPort scanner for just this purpose; he says that he's even packed it along with him on the road. Hmm. Maybe if I upgraded to an 810MB drive and ran Stacker. . . . □



The key to happiness? Disk storage! The more room you have, the more cool things you can do.

Illustration by Carolyn Fisher

Win-Win!

PC MAGAZINE EDITORS' CHOICE

May 30, 1995

Austin PowerPLUS-100

"The Austin PowerPLUS-100 is one of our favorites."
— PC Magazine

- 100MHz Intel® Pentium® Processor
- 16MB High-Speed RAM
- 256KB High-Speed L2 Cache
- 64-Bit PCI Video Accelerator – 4MB VRAM
- 4X Enhanced IDE CD-ROM Drive
- 28.8Kbps Fax/Modem
- MS-DOS 6.22, Windows for Workgroups 3.11
- Pre-Installed Microsoft® Office Standard or Professional Available
- 3-Year Parts & Labor Warranty
- 7-Day/24-Hour Lifetime Tech Support
- Energy-Star Compliant
- Desktop or Mini-Tower Chassis

Austin PowerPLUS-75

"A full-featured machine at an eminently reasonable price."
— PC Magazine

- 75MHz Intel Pentium Processor
- 16MB RAM
- 256KB Asynch L2 Cache
- 64-Bit PCI Video Accelerator – 2MB DRAM
- 4X Enhanced IDE CD-ROM Drive
- MS-DOS 6.22, Windows for Workgroups 3.11
- Pre-Installed Microsoft Office Standard or Professional Available
- 3-Year Parts & Labor Warranty
- 7-Day/24-Hour Lifetime Tech Support
- Energy-Star Compliant
- Desktop or Mini-Tower Chassis

intel inside pentium PROCESSOR

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Austin's PowerPLUS desktop systems are making an impressive debut. **Fast, Faster, Fastest. . .** *PC Magazine*, in its May 30, 1995 issue, awarded its prestigious Editors' Choice to not one, but *two* of these Pentium processor-based systems – the Austin PowerPLUS-100 and PowerPLUS-75. And our PowerPLUS-120, with the fastest Pentium architecture available as well as 100MB/second PCI combined data streaming, won an Honorable Mention in the same review!

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CIRCLE 066 ON READER SERVICE CARD

Bill Machrone

Second Looks

LIVING WITH THE PRODUCTS WE REVIEW

Tektronix Gets a Second Round of Applause

A guy comes up to you and says, "I've got a great idea for a new color-printer technology. You coat a drum with silicone oil, melt some crayon-like wax sticks, spray the molten wax onto the drum, run a piece of paper under the drum, and squish the wax

onto the paper." You say, "Nahh. It'll never work."

Oh, but it does! Our Phaser 340, from Tektronix, with its $4,995 price tag, has been chunking out great-looking color at four pages per minute and shows no sign of slowing down. The color-laser vendors are worried: The only area where they're clearly superior is on black text pages. The Phaser 340's cost per page is lower than any competing technology's, and the printer's network utilities are very well thought out.

Not that the 340 isn't without its oddities. The 15-minute warm-up cycle sounds as if miniature medieval torture devices are in use inside. The LCD panel vacillates between telling you that you have 13 or 14 minutes to go—right up to the point that the ready light comes on.

Never mind the sound effects or the shoddy timekeeping; this is a machine that you want to put on your network (Ethernet is built-in) and leave on. Another reason for leaving the printer on is that its warm-up cycle wastes a lot of crayon as it goes through a melt-and-purge operation and drops yummy purple leftovers into a catch tray.

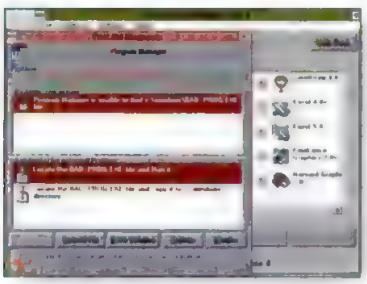
Our first look (First Looks, April 25, 1995) at Tektronix's technological marvel was a rave—and so is our second.

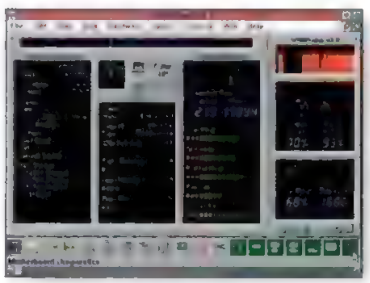
Tell Me About Your Christmas Machine

For an upcoming Second Looks I'd like to hear from readers who bought multimedia machines last fall. Do those 4MB 30- through 60-MHz DX and Pentium machines still make the grade? How's the sound card? The CD-ROM? Did you get enough memory on your video card? Are you happy with the overall performance? What would you do differently now that you've lived with the machine for six months? Are you going to upgrade it? What components have you changed already? Are you using any of the Multimedia PC's "advanced" features, such as voice recognition, telephone or TV, or fax send/receive?

WINProbe Fixes Problems; First Aid Fixes Price

Landmark WINProbe 3.0 took it on the chin in Second Looks, April 25, 1995, for some serious problems. Landmark has since come out with a patch that updates Version 3.0 to 3.1, which you can download from its CompuServe forum (GO LANDMARK, Library 12, WINP31.EXE). Users say the utility crashes far less but is still not entirely problem-free. The RAM test still doesn't get along with SmartDrive; you have to add a REM line to your configuration to use WINProbe. The CPU speed detect isn't always accurate, and some TSRs and nonstandard mouse drivers can occasionally trip it up.





First Aid for Windows was always a good program (First Looks, November 8, 1994). It's especially handy for fixing those frustrating errors when your applications can't find pieces of themselves. But our reviewer balked at the $129.95 list price. Good news: First Aid is now $49, and it comes bundled with PC 911 (a convenient DOS-based program that troubleshoots configurations and board conflicts) for $59. The copy we reviewed last fall had a knowledge base that knew about 17 major products. The number is up to 50 with another 35 due by the third quarter of 1995. You can download a sample of First Aid from Cybermedia's BBS at 310-789-4196, and it'll be on CompuServe soon (GO CYBERMEDIA).

How to contact Second Looks: On ZiffNet type GO ZNT:EDITOR, and choose Views: Machrone. Contact Machrone directly via MCI Mail at Wmachrone or CompuServe at 72241,15. You can also find us on the World-Wide Web at *http://www.ziff.com/~pcmag.*

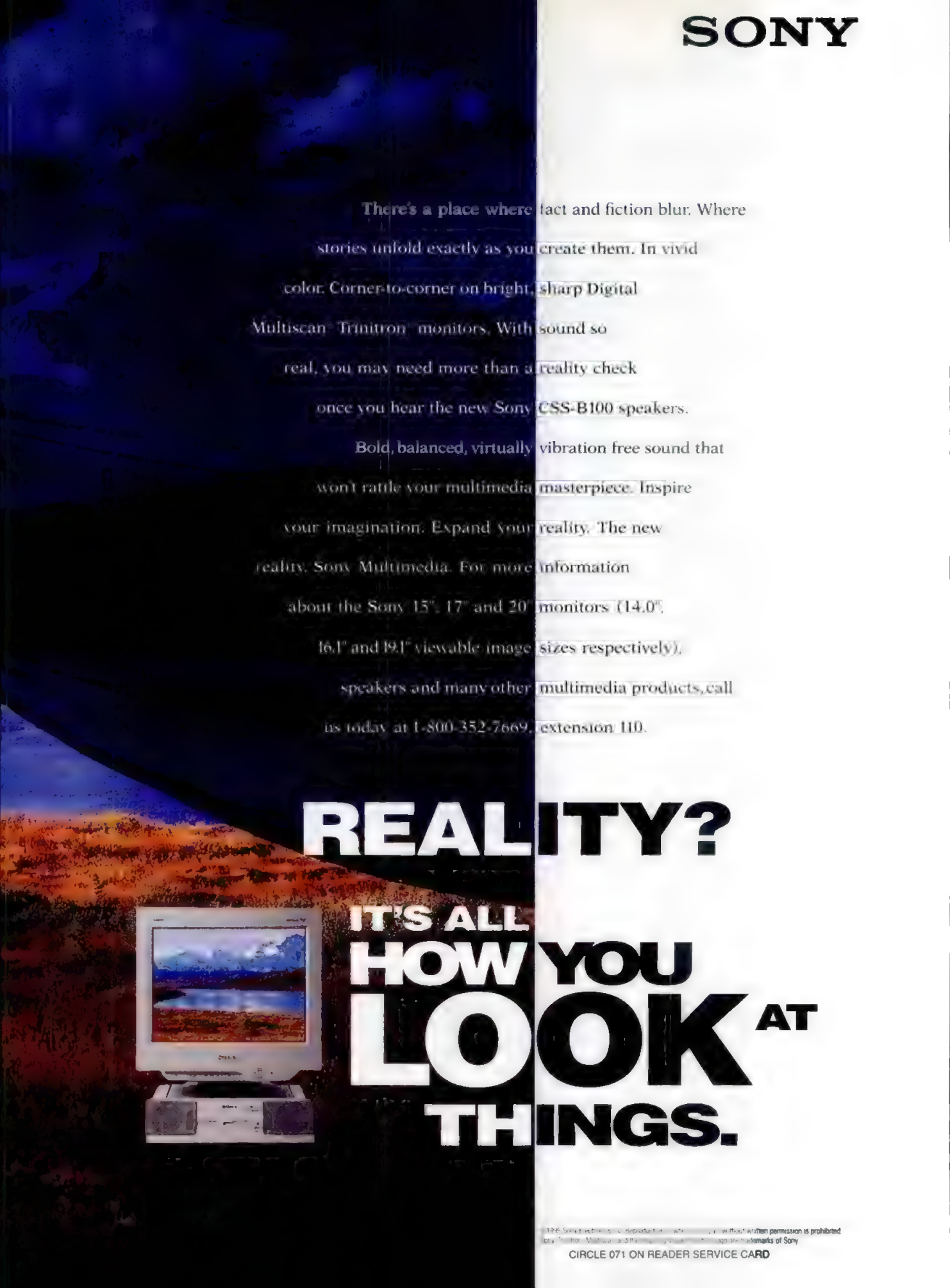
LOOKING AHEAD

Tell me what you love and hate about these products and we'll share the information in future issues.

Autodesk 3D Studio	Quad-speed CD-ROMs
Diamond Stealth 64 Video	Vertisoft Remove-It
IBM ThinkPad 755CD	Toshiba Portégé T3600CT
LANtastic for OS/2	WordPerfect 6.1
PCMCIA modems	ZDS Z-NoteFlex

Illustration by Alan Boucek

INSPIRING VISION
Trinitron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yes It runs with NetWare

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Pentium-90	**$3795**
Pentium-100	**$3945**
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- **24MB RAM**, 256K SRAM cache
- 6 SIMM slots for easy, low-cost upgrading. RAM expandable to 384MB
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- Diamond Stealth 64 PCI local bus SVGA color graphics card with 1MB DRAM upgradable to 2MB DRAM
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- Two high-speed serial ports and one enhanced parallel port on the motherboard
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- 32-bit PCI local bus SCSI controller
- Optional on-board PCI local bus Ethernet LAN
- Flash BIOS for easy upgradability
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- EPA Energy Star compliant (75, 90 & 100)
- MS-DOS 6.2, Windows for Workgroups 3.11, Microsoft Mouse

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486DX2-50	**$1295**
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- Intel's Pentium™ OverDrive™ upgrade socket
- 8MB RAM, 128K SRAM cache
- RAM option to 32MB
- 528MB IDE hard drive, 120K cache
- 3.5" 1.44MB floppy drive
- On-board VESA local bus SVGA color video
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- Two serial ports, one parallel port and one mouse port integrated
- Small footprint case with four bays
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- 200 watt power supply, switchable between 115/230V
- ZEOS 101-key space-saving keyboard
- Password feature built in ROM for security
- MS-DOS 6.2 w/Enhanced Tools, Windows for Workgroups 3.11, Microsoft Mouse
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CIRCLE 038 ON READER SERVICE CARD

John C. Dvorak

Gripe List '95

I was reading about the new FireWire technology and how it's going to speed up—er, sorry—"revolutionize" the serial port. The writer went on and on about FireWire and other competing technologies designed to speed up the poky old serial port. Yawn.

For anyone who hasn't noticed, everyone still uses the same standard RS-232C serial port. It dawned on me as I read about FireWire that these promises of new designs were just another instance of industry-speak to make you think things are changing, and changing fast.

Let's look at the recent spate of false promises:

A new, fast serial port. FireWire, the universal serial bus, and other schemes abound, but some manufacturers won't even use a 16550 UART. Give me a break.

Enhanced parallel port. Remember this promise? At least three schemes were on the table to make the parallel port into a speed demon. Most manufacturers still feel the old Centronics interface is fine. Heck, few machines out there even have the circuitry to make the parallel port bidirectional, as many OS/2 users have discovered.

Emulators that work. How many years must pass before software emulation works properly and fast? This is obviously a nontrivial effort, but is it impossible? I suppose that Microsoft and others have made this more of a problem, since Windows itself is bloated with code and requires hardware acceleration for mundane things like video. I laugh when I see a Mac trying to run a Windows program via emulation, without all the Windows-optimized video display cards found on a typical PC. What a pig.

Plug-and-play. I'll believe it when I see it.

Mice that don't need replacing. Has anyone noticed that the mouse gets dirty and the cursor is all over the place or refuses to budge? Eventually every mouse becomes unusable, even after a thorough cleaning.

Stylish PCs. I want computers colored something other than beige. Thank God Henry Ford isn't alive and making computers. These things would all be black. Kudos to companies like Nokia that are coloring their monitors.

A variety of computer voices. Has anyone noticed that the computer-generated voice of today sounds a lot like the same ones we had 15 years ago? That stilted buzz saw: "Hell-oh, I yam the VO-ice of thuh COM-puut-er." Can't this be improved somehow? I mean, did the inventor of this technology die and take his notes to the grave?

SCSI that works better. I used to say SCSI doesn't work. Well, there has been a big improvement since the ASPI driver was developed, at least when it comes to finding a SCSI device and recognizing it. But that still doesn't get us to Macintosh-level SCSI, where the device is recognized and immediately works. With the PC, you still need drivers and software that tends to be linked to a driver. I have encountered too many situations where the ASPI driver sees the device, then the driver sees the device, but the software still doesn't work.

More colorful screen. It's bad enough that modern operating systems such as OS/2 default to 640-by-480 resolution at 16 colors, as if anyone is running a video card that can't do more than 16 colors. Today, 256 colors is ludicrous, and 34,000 colors should be the default, with 16 million colors more typical. I mean how much more does it cost nowadays to put the full color spectrum on the screen?

A true backup standard. When will these backup people realize that their market will never improve unless they agree on a standard for the various backup tapes? You should be able to take a tape from one system and use it on another manufacturer's system. How many DAT-format tapes can be used on different DAT backup devices? This stinks.

I could go on. The gripe list is long and hopeless. Send me a list of your personal gripes. Meanwhile, they're telling us to look forward to FireWire. In a pig's eye.

Plug-and-play. I'll believe it when I see it.

Illustration by James Steinberg

Which Database is Easier to Use?

Access vs. Alpha Five

60 Lines of Code

Microsoft Access

If this looks tough, you may want to pick up a few books about Access programming.

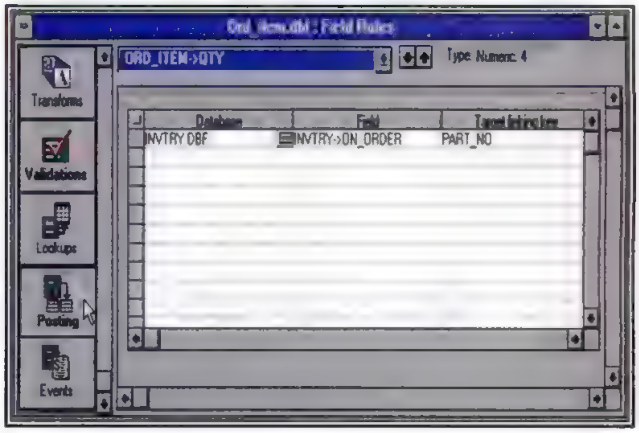
```
Sub Form_AfterUpdate ()
   Dim varRet As Variant
   Dim lngNewItemID As Long
   Dim dblNewQuantity As Double
   Dim qdfInventory As QueryDef
   Dim dbCurrent As Database
   Dim rstInventory As Recordset
   Dim intResponse As Integer
   Dim strMessage As String
   Const MB_YESNO = 4
   Const MB_ICONQUERY = 32
   Const MB_DEFBUTTON2 = 256
   Const ID_YES = 6
   Const ID_NO = 7
   Set dbCurrent= dbEngine.Workspaces(0).Databases(0)
' First, renumber any order lines that have changed
   varRet = RenumberDetail()
' Now, deal with inventory problems
' First, get the new item and quantity for this line
   lngNewItemID = Me![ItemID]
   dblNewQuantity = Me![Quantity]
' To update the inventory,
'   first, run the query to add the old items back in
'   then, run the query to remove the new items
   Set qdfInventory = dbCurrent.OpenQueryDef("qupdAddIngredientsForItem")
   qdfInventory.Parameters(0) = dblQuantity
   qdfInventory.Parameters(1) = lngItemID
   qdfInventory.Execute
   qdfInventory.Close
   Set qdfInventory = dbCurrent.OpenQueryDef("qupdRemoveIngredientsForItem")
   qdfInventory.Parameters(0) = dblNewQuantity
   qdfInventory.Parameters(1) = lngNewItemID
   qdfInventory.Execute
   qdfInventory.Close
' Now, have we run out of stock on anything?
   Set rstInventory = dbCurrent.OpenRecordset("qryExhaustedIngredients", DB_OPEN_SNAP
     SHOT)
     ' If there are any records here, we've got a problem
         If Not rstInventory.EOF Then
            Do While Not rstInventory.EOF
               strMessage = "Warning! Out of stock on " & rstInventory![Description] & ".
            Continue?"
               intResponse = MsgBox(strMessage, MB_YESNO + MB_ICON QUERY
                  + MB_DEFBUTTON2,
                                "Inventory Warning")
                                If intResponse = ID_NO Then
                                   ' Go back to original values and pass up the rest of the
                                     recordset
                                      Me![ItemID] = lngItemID
                                       Me![Quantity] = dblQuantity
                                        ' Remember to reverse the changes
                                         Set qdfInventory =
                                          Current.OpenQueryDef
                                             ("qupdAddIngredientsForItem")
                                           qdfInventory.Parameters(0) = dblNewQuantity
                                           qdfInventory.Parameters(1) = lngNewItemID
                                           qdfInventory.Execute
                                           qdfInventory.Close
                                            Set qdfInventory =
                                           dbCurrent.OpenQueryDef
                                               ("qupdRemoveIngredientsForItem")
                                            qdfInventory.Parameters(0) = dblQuantity
                                            qdfInventory.Parameters(1) = lngItemID
                                            qdfInventory.Execute
                                            qdfInventory.Close
                                            rstInventory.MoveLast
                                             Exit Do
                                           End If rstInventory.MoveNext
                                                  Loop
                                             End If
                                             rstInventory.Close
                                             dbCurrent.Close
                                           End Sub
```

**Source: Microsoft Access Advanced Programming Seminar ©Application Developers Training Company*

One Easy Table

Alpha Five

Just fill in the table. That's all there is to it!



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John C. Dvorak

Inside Track

Intel is on the move again. The venerable processor maker introduced the **133-MHz Pentium** right after Spring Comdex, and the 150-MHz CPU is not far behind. Considering how long different versions of the 486 CPU have persisted on the market, **I'm stunned** at how fast things are now moving. Expect the first systems with 133-MHz Pentiums to hit the market sometime in early summer.

I was interviewing a game developer the other day, and he told me that few (if any) high-end PC games written in the next year will even work on a 486 system. **Amazing progress,** and Intel still claims that it will ship its next-generation processor, the P6, before the end of the year. I think that may be overly ambitious and pushing it a bit.

Panels that display 800-by-600 resolution are just now appearing in bulk, but they'll be the low-end standard by this time next year. Some vendors are skipping 800-by-600 screens and going directly to 1,024-by-768 panels.

Spring Comdex Atlanta 1995 Dept.: Never a show where a lot of new products are rolled out, this year's Spring Comdex is still less crowded and more manageable than the fall extravaganza in Las Vegas, which is **horrible.** The company that produces Comdex has recently been bought out by a Japanese company, Softbank, which promises that the shows will be **kinder and gentler.** The old management remains in place, so it will likely be some time before anything concrete happens. One noticeable trend at Comdex is the **ever-enlarging** souvenir booth, where you can buy a cute T-shirt for your kid that says, "When I Grow Up, I Want to Go to Comdex!"

A couple of **interesting observations** from the show floor. Expect to see high-resolution liquid crystal displays emerge in the next generation of notebooks. I saw several 1,024- by 768-pixel flat-panel displays capable of showing 64,000 or even 256,000 colors. Panels that display 800-by-600 resolution are just now appearing in bulk, but they'll be the low-end standard by this time next year. Some vendors even tell me that they are planning on skipping the 800-by-600 screens and going directly to the higher-resolution 1,024-by-768 panels. NEC was showing a 1,280-by-1,024 display at Spring Comdex that the company is pegging as a replacement for the 14-inch CRT monitor. These panels vary in size, but from what I've seen none are **bigger than 14 inches,** measured diagonally.

A company at Spring Comdex called Computer Dynamics (803-877-8700) was showing a line of interesting flat-panel displays that incorporated touch sensitivity. This vendor also had a very small 4-inch screen that, as far as I could tell, had **no limitation on viewing angle** and could be seen clearly from everywhere.

Touch screens come and go but never go away. If you are interested in touch-screen technology, contact the people at Dynapro Thin Film Products in Milwaukee (414-365-3555). At Comdex they were **showing a broad line of amazing thin-film devices** that you can place on a regular monitor to turn it into an incredibly accurate touch-sensitive screen. It was impressive, and I was told the cost would be about $80 or so to outfit a monitor with the thin-film overlay. It uses something called Analog Resistive Touch Panel technology. The touch panel uses two opposing, transparent resistive layers consisting of **sputtered indium tin oxide** overlaying a silver ink-based bus bar. The beauty of this product is that the thin but rugged film acts **like millions of tiny switches** lying almost invisibly on top of the monitor's face. The screen works perfectly, but watch out for fingerprints. If you have any need for touch-sensitive technology, look no further.

Genuinely Interesting Hardware Dept.: Check out this $199 device that turns your camcorder into a digital camera. Called the Snappy Video Snapshot, it's from a company near Sacramento, California, called Play Inc., and it was shown at Spring Comdex in its final version. Using a special video-capture chip, this hand-held device will grab and tweak amazing high-resolution images (up to 1,500-by-1,125 resolution) from any video source. It hooks to a PC's parallel port. The images it produces can then be moved right into Photoshop or manipulated with the software that comes with the device. I've used this thing and **I'm actually astounded** by how well it works. I installed the software on my laptop and entertained the kids for hours by capturing and manipulating frames from old family videotapes. This is not at all complicated, and the results are **astonishing**. Egghead has this thing featured in all its stores. Get one—you'll love it. It comes with image-enhancement software, **morph software,** and other utilities. Call the company for more information at 916-851-0800. In addition, Minolta has hooked up with the Play people, and I'm sure that a standalone super-duper digital camera will be in the offing sometime soon.

A Surge Suppressor That Looks Cool Dept.: Panamax, in San Rafael, California, has added flair to its surge suppressor, making it modular. You can attach a phone-line protector, a network protector, or any combination onto the main unit. It's by far the best-looking surge suppressor. (Zero Surge, **a connoisseur's surge protector,** is my other favorite.) Panamax's Max 6 unit will protect against lightning "guaranteed"—Panamax will **replace your equipment** if the surge protector doesn't protect it. **Cheap insurance.** These things cost about $100 without the add-on modules, which are about $30 or so each. I swear by my surge suppressor. □

A word about Viking Components:

Innovation

The Dictionary defines innovation as the act of introducing something new. But at Viking Components, there's nothing new about it. In fact, at Viking, innovation occurs at about the same frequency as sunrise...every day.

We were the first to introduce an upgradeable SIMM for Apple's Powerbook Duo series. We were the first to ship upgrades for Compaq's LTE Elite series of notebooks using low-power 3.3 volt chips. We are the only third party memory manufacturer making 16Mb upgrades for the Tektronix Phaser 440 Laser Printer. We even helped pioneer S.O. DIMM technology to fit even more memory into less space. And the list goes on.

We also are one of only a handful of companies worldwide with the capability to manufacture credit card memory. And yes we also make expansion boards. In all we manufacture over 900 different memory products for Apple to Zenith and everything in between. All guaranteed compatible. All backed by our exclusive *Lifetime Service & Replacement Warranty.*

If you're looking for something new, call Viking Components. If you're looking for someone who thinks innovation is something new...well...you'd better keep looking.

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Jim Seymour

Moving Bits, Not Atoms

And now for a stroll down the other side of the street. Last time, I wrote here about how new tools have changed some of my beliefs and work habits. For example, after arguing long and loud against carrying portable printers—they're too heavy and too clumsy, and there are other, better alternatives when you need hard copy on the road, said I—I confessed that I like the new Canon BJC-70 portable color printer so much that I've begun carrying it on many business trips.

A new tool had appeared that was much better than what was previously available; I tried it; I found that it could make my life a little easier. So I changed. (Oh, my friends and family might add here, would that I were so open-minded about *other* things. . . .)

A few days after I'd finished that column, I was talking with an editor here and told him about it. He gasped, "A *printer*? Something that spits out *paper*? Isn't that awfully. . .*retro*?"

He was smiling, but he had a point. No doubt some readers had the same thought. Aren't we squarely into the digital age, when we're supposed to be shipping bits, not atoms, around? "What about e-mail?" he asked. "Fax?" Am I really serious about going backward, adding a printer to my bag of road-warrior tricks?

BITDOM OR BUST

Well, I ship a lot of bits around, too. I'm a heavy user of e-mail: I probably get 50 e-mail messages a day in my various accounts, and I send that many or more myself. I send and receive a lot of faxes too.

But I've gotta confess something: I don't find the idea of ink on paper all that retro or that unsettling. Because in the world I live and work in, despite our inexorable and, in many ways, welcome march toward "bitdom," Paper Rules.

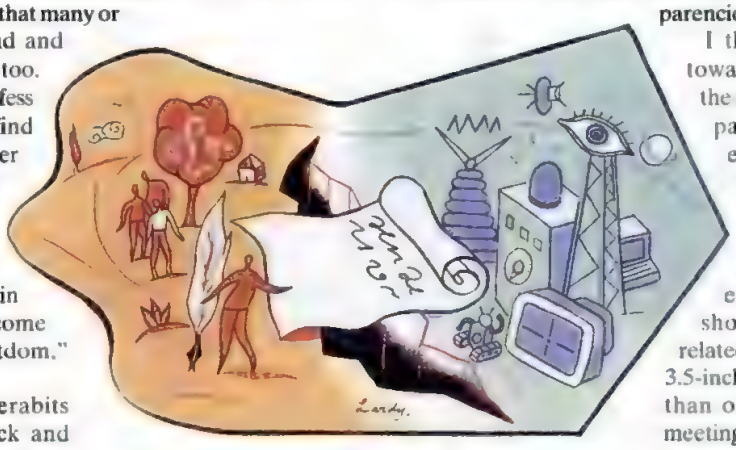
We ping-pong terabits of information back and forth every day electronically, and many of those bits carry absolutely essential information—my bank balance, for example. But much of the information that I rely on, that my family relies on, that my colleagues and clients rely on, still comes to us on paper. And that's not changing anytime soon.

HARD COPY COUNTS

Much of this notion of still using paper is simply good business. Many of the people I work with happily exchange information electronically all day long; they're hardly computer-hating Luddites. But they are used to seeing the final result and probably several interim stages of their work on paper—especially when it comes to complex or important projects. When I work with people who expect paper, I give them paper.

When a client looks up with a surprised grin as I hand him a good-looking interim summary, complete with color graphs and maybe a color-coded time line, of a set of recommendations we began work on that morning, I know paper counts. When he asks if he can have a copy to show someone else, and I say "Sure, it'll just take a few minutes," I know paper counts. And when he asks if we could make a couple of overheads of the graphs for our pitch to the project committee this afternoon, and I tell him I'll have them in 10 minutes, I *know* paper and paperlike overhead transparencies count.

I think I do my part toward chipping away at the mountains of wasted paper we produce every day. I've written here about my success in distributing previously prepared computer-generated slide shows and the text of related files and reports on 3.5-inch floppy disks rather than on paper at clients' meetings (see "Breaking the Paper Chain," *PC Magazine*, January 25, 1994). It's a process that works well, and the longer I do it, the more both my clients and I



The trick isn't to be the first to adopt new tools, but to use new tools and technologies selectively.

Illustration by Philippe Lardy

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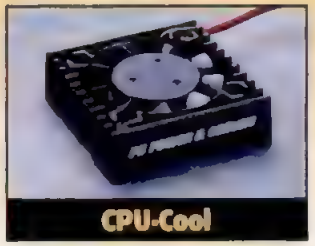

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Excess inventory today....student opportunity tomorrow

Jim Seymour

like the idea. I've changed some minds and habits, and that feels good.

But going entirely digital too soon—getting there ahead of your audience—is foolish and self-defeating. Delivering information in a familiar form—on paper—makes that information more acceptable and thus more likely to be acted on favorably.

I'm always a little disappointed when friends and colleagues are so surprised, even taken aback, by my use of familiar, ubiquitous tools rather than the newest and jazziest technology. The trick isn't to be the very first to adopt new tools and then to become a loud advocate for their immediate and widespread adoption, but to use new tools and technologies selectively. Add them to your arsenal because they help you work better and communicate better, not because they're new and flashy—which too often means they're really just distracting and confusing.

Remember when laser pointers first appeared a decade ago? Overnight, it seemed every presenter had one—even people who hadn't previously used slide shows!—and spent the first couple of minutes of each presentation waving them around and making awkward show-off jokes about that little red dot on the screen.

Today, laser pointers have shrunk from cop-on-the-beat flashlight size to the size and shape of a ballpoint pen. And though they're common enough now, they come out only when needed. . .and no one pays much attention to them anymore, just the information they're highlighting.

It's the same story with other tools, from telexes to conference calls to fax machines. Remember when faxes seemed so exotic and expensive? The value of these technologies lay not in themselves but in how well and how transparently they supported the exchange of information.

We're on the cusp today between the Paper Age and the Digital Age. Both this moment and the future belong neither to those who remain resolutely in the former, worrying over the passing of carbon copies, nor to those who completely embrace the latter, seeming to live by e-mail and on-line airline-schedule services.

The present—and the future—belong to those who, understanding the use of digital tools, stand astride those two sometimes antagonistic epochs, bridging them with tools that are familiar to inhabitants of both worlds. □

Bill Howard

What's the Matter with Today's CDs?

CD-ROM software is addictive. The more you use it, the more you love it—and the more frustrated you become with its glitches, large and small. We all know CD-ROM software is here to stay, but improvements must be made. So what's wrong with the CD-ROM software we use today? Here's a rundown of my personal CD peeves.

Not enough content. Many programs give you tidbits of information when you want full meals. A case in point is the quotes section of Microsoft Bookshelf. Twenty-thousand quotations seem a lot, but try to zero in on a topic or find the exact wording of a quote you think should be there, and probably isn't.

Too much content to fit (so they lop some off). Most encyclopedias are short on information because if you ran all the text, pictures, and multimedia clips that are now de rigueur, it wouldn't fit on a single 660MB CD. And vendors are scared of selling multiple-disk titles that require disk-swapping. Fortunately, we're seeing the advent of dual-CD PCs and affordable multidisk CD changers.

Inaccurate data. Material that's transcribed by hand-rekeying isn't proofread thoroughly (quick test: search for "Untied States"). Other facts are flat-out wrong, because the original source was wrong or because time-to-market pressures didn't allow for fact checking. Or information is incomplete, because the material is dated. Often, 1995 almanacs and data books stop with 1993 or 1992 material and, except in a few high-priced reference titles, there are no "go on-line to get the current data" links.

The CD-ROM version costs too much. The right price for PC-based entertainment software is $19.95, because that's what videotapes cost. But when *The Lion King* pulls in $100 million at the box office, you can make money releasing it on video at $20, while a competitor struggles to break even releasing a Jungle Animals encyclopedia at twice the price on CD-ROM. You could buy three or four audio CDs for the $40 to $50 street price of Bob Dylan: Highway 61 Interactive. Are a couple of video clips, on-screen liner notes, and a previously unreleased version of "House of the Rising Sun" worth an extra $35?

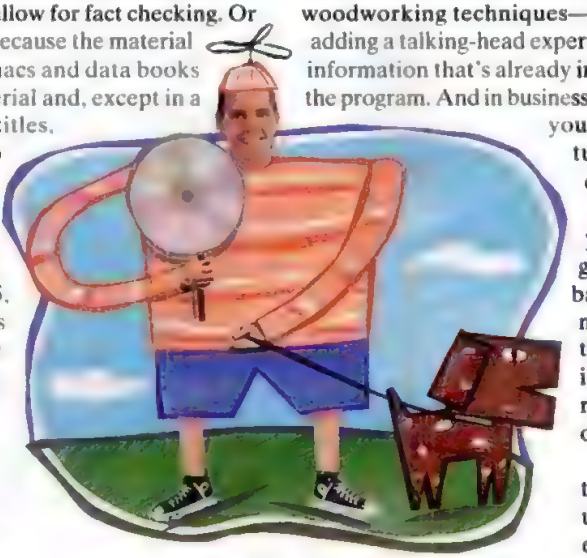
They've gone Hollywood on us. Opening scenes blast the cosponsors' names loud enough to make you reach for the volume knob. Cover your ears when your kids start up Micrografx's Crayola Art Studio and Amazing Art Adventure. (To be fair, the disk versions do it, too.)

Cute wins over useful. Too many encyclopedias devote a quarter screen or less to the text window for an article; the rest is given up to cute borders, hot links, and click-here-to-see-a-slow-and-grainy-video windows. Often there's no text-only, full-screen option, so you never see more than one or two paragraphs of the longest articles.

Do I hate all CD-ROM software? Heck, no. CDs are great for loading software; any app that comes on more than three disks should also include a CD for quick installation. Kids' software and games are better with the scenery and animation a CD affords. How-to video clips make sense for demonstrating things like cooking and woodworking techniques—far more sense than, say, adding a talking-head expert who self-assuredly recites information that's already in the disk-based version of the program. And in business, CD software allows for at-your-desk multimedia-based tutorials that may bring down training costs.

What should you do? If you buy a CD-ROM program and it's terrible, take it back. Even if the package mentions a no-return policy, the store where you bought it will probably let you return it; you aren't the only one who's unhappy.

Meanwhile, the flood of terrible CD titles should dry up as investors stop funding every programmer with a multimedia dream. The investors have gone off to throw money at the Internet—where they may lose their shirts again. □



CDs, our future software candy, can sometimes leave you with a bitter aftertaste.

Illustration by Tom Garrett

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NETWORK EDITION

COVER STORY

CLIENT/SERVER COMPUTING

The Best Notes Server

Now that you have a choice among Notes server platforms, which is best for you?

By Tony Pompili

In the beginning, there was Lotus Notes Server for OS/2 and not much of a decision: Do I install Notes on OS/2 or OS/2?

Over the past year and a half Lotus has unleashed a barrage of new Notes Server versions—for Microsoft Windows NT, Novell's NetWare, and Unix. Managers at new sites wonder which platform is best. At existing sites, Notes architects question whether they should change to a new platform or leave well enough alone.

Illustration by Kate Mueller

PC MAGAZINE

Lotus Notes has become a way of life at more and more offices, including ours at *PC Magazine*. Fortunately, most of us never face the challenge of supporting such a complex application. Our far-flung reviewers, writers, and editors simply enjoy using the unique discussion databases and the mail to track and plan many projects at once.

OUR COVER STORY DIGS deeper into Notes—from the administrator's perspective. With Notes now running on several major platforms—OS/2, NetWare, Unix, and Windows NT—we set out to find the best server in terms of setup, management, performance, and scalability. Though results at the client end were most important to us, we also saw some surprising things going on at the server end. These results and our findings about manageability have implications for other processor-intensive client/server applications.

TO GIVE NOTES room to breath, we snagged the 120-node test-bed at ZD Labs in Foster City, California, and sent veteran Notes guru, consultant, and author Tony Pompili out to put the server platforms through their paces. This issue is the culmination of weeks of blood, toil, tears, and sweat in our first large-scale testing of Notes servers.

OTHER INTRIGUING developments await you in First Looks. Digital Equipment Corp. takes its first step into the remote-access market with the NetRider 90 M, and there's a lot to like about it. Digital reaches out to new customers while also paying attention to its long-standing base. Cheyenne, long a leader in backup with its ARCserve line, has released a Windows NT version. Windows NT continues to gather important third-party support as a networking entity. —*Gail Shaffer*

"The Ultimate SMP Pentium Server Solution"

In PC Magazine's latest Service and Reliability survey, Micron received the highest scores in all four categories: Satisfaction with Reliability, Satisfaction with Repair Experience, Satisfaction with Technical support, and Future Likelihood of Buying. (PC Magazine--January 10, 1995.)

SERVICE & RELIABILITY · PC MAGAZINE · READERS' CHOICE

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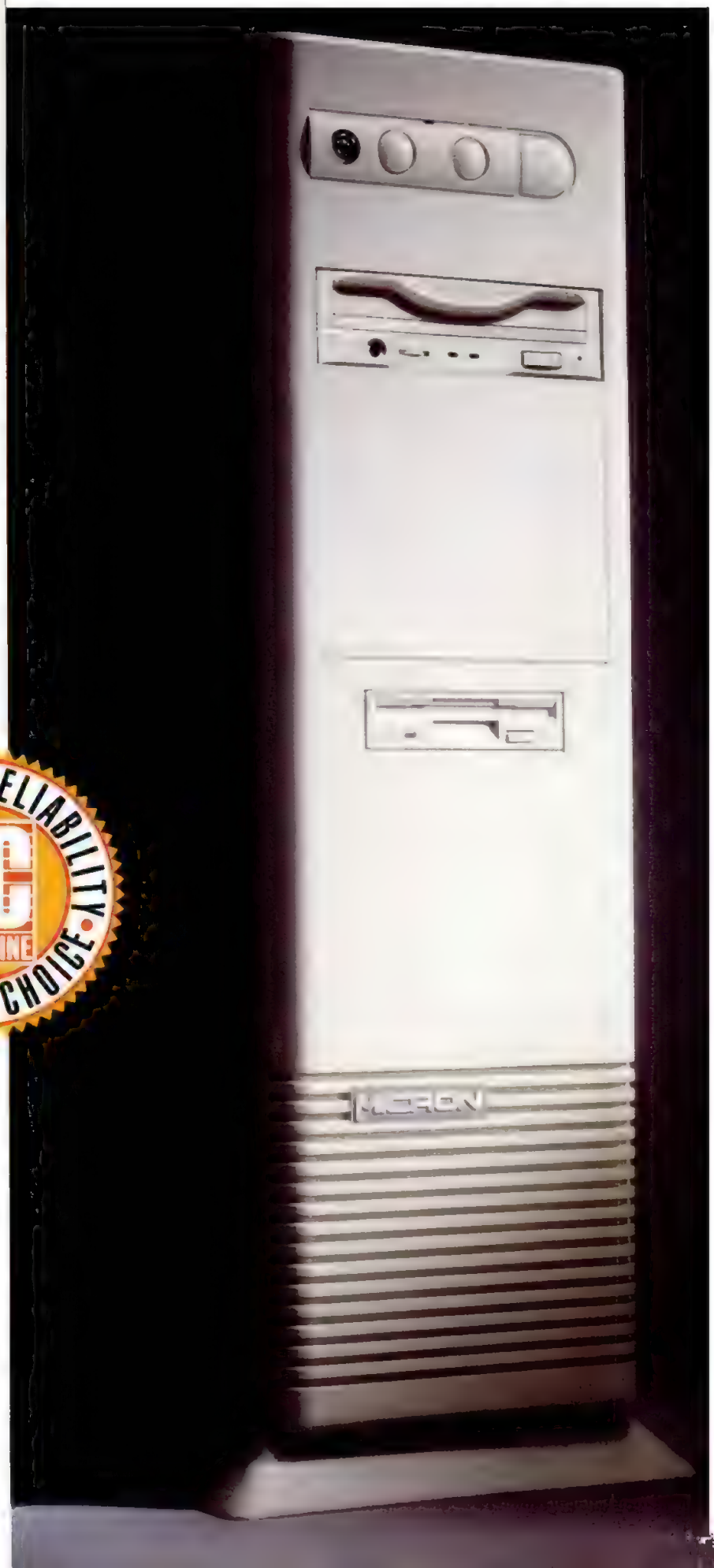
IBM	8.2	7.6	7.4	6.5
COMPAQ	8.4	7.7	7.7	7.4
HP	8.4	7.8	7.7	7.1



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CIRCLE 924 ON READER SERVICE CARD

For existing sites:

Lotus Notes Server for OS/2

For new sites:

Lotus Notes Server for NT

When we set out to find the best Notes server, we thought that it might be the same for both new and existing sites. It turns out that the veteran Lotus Notes Server for OS/2 competes well against its newer siblings. It's also the most flexible server here, supporting all Notes protocols. In addition, the majority of add-in processes still run only on OS/2, and there's a ton of expertise out there for it.

New sites would be better served with Lotus Notes Server for NT. Setting up networking with Windows NT is far easier than with OS/2. In addition, Windows NT's SMP support is a good investment, especially as Notes moves to more extensive SMP support in Release 4.

Finally, Lotus Notes Server for NetWare deserves an honorable mention. In testing, it outperformed both the OS/2 and Windows NT servers, and it supports a larger numbers of users.

PC MAGAZINE NETWORK EDITION EDITORS' CHOICE

In this article, we bring clarity to this murky decision process with our first large-scale, cross-platform evaluation of Notes servers. We evaluated the four major platforms: Lotus Notes Release 3.3 Server for Microsoft Windows NT, for NetWare, for OS/2, and for Sun Solaris 2.3 and 2.4. Other Unix versions are available, but Solaris is representative of Unix's potential here. We didn't include Notes Server for Windows, because it is better suited for smaller sites of 20 to 30 users.

Note that this review is for Lotus Notes Release 3.3. With Release 4 due out by year-end, the questions will need to be asked all over again.

TAKE NOTE OF THESE SERVERS

Our results surprised us somewhat. We thought that strong new OS platforms might sweep away the old standards (like OS/2). It turns out that for all the potential there, we recommend that existing sites stick with OS/2. It's still an all-around good performer, it has a four-year track record over the others, and there are tons of technical expertise out there.

Notes Server for OS/2 is also a good choice for new sites—but here, equal consideration *must* be given to Notes Server for NT. With performance comparable to—at times, better than—the OS/2 version, and other inherent Windows NT qualities, such as its remarkable ease of networking administration, Notes on Windows NT is an easier setup and a trustworthy platform. You'll probably still need to build an OS/2 server or two, though, to run any of the mail gateway or other third-party Notes add-in processes.

BUT WAIT, THERE'S MORE

We put the Notes servers through the wringer on the 120-node test-bed at ZD Labs in Foster City, California. We ran a series of performance tests, each starting with 15 users on each server and adding users in increments of 15. We were looking for robustness and scalability. Our reviews, benchmark test results, and comparison chart cover a lot more territory.

Our grueling tests showed that these Notes servers do not perform comparably across the tests. That is, you must consider the type of tasks your user community will principally be engaged in. For example, Notes Server for Sun Solaris outperformed its Intel-based brethren as a mail server, but it flopped as a database server.

Conversely, the OS/2 and Windows NT Notes servers both exhibited robust database server potential but were not equally up to the task as mail servers. Notes Server for NetWare fell into a unique niche of supporting large numbers of simultaneous database and mail users as long as user activity was medium to low and server tasks were minimal. Past that, the NLM version checked out.

We also uncovered a little-known limitation with Notes. Lotus has confirmed our finding that Notes does not allow more than 105 active databases to be open simultaneously.(That ceiling applies no matter how large a server you build.)

A CHANGE OF SCENERY

What's in store for you if you think you want to change to a new platform? Solaris shone as a mail server, but Unix-based Solaris and Sun workstations are new terrain for many Notes folks. The Intel-based platforms that run Windows NT, NetWare, and OS/2 are old hat—much easier to install or change to.

But how easy is easy? We think Windows NT is terrific in this regard. Its support for NetBIOS—the most common client-to-server protocol used by large Notes sites—and its popular Windows interface make the NT server simple to learn and work with. NetWare is another natural; many large sites already have IPX/SPX installed on their client PCs, although some changes to each client system are necessary.

Solaris—or another Unix version—represents the most difficult changeover because you'll need a hard-core Unix guru and relatively expensive Sun hardware. On the other hand, if you're looking to break into Unix territory for this and other applications, this could be the one to run with.

Looking ahead to Notes Release 4, you should also take into account the added scalability that NT and Solaris offer in their support for symmetrical multiprocessing (SMP). This will come in handy for expanding multiprocessor servers that, under Release 4, could support 500 to 1,000 users.

PUTTING THE PEDAL TO THE METAL

We developed our testing approach with input from members of the New York Notes user group, made up of system builders of some of the largest Notes sites. We also received input from Lotus and brought to the mix our own first-hand experience in installing, administering, and troubleshooting large Notes networks.

Our tests focused heavily on user benefit because the most common complaint about Notes is that users find it slow. But while we concentrated on user response, we didn't ignore the back end. We monitored server processes, to ensure that while client requests were being responded to, the server was not falling behind with its processes.

We mirrored the trend that many companies follow in specializing their Notes servers into database and mail servers. But we isolated the big three task masters—the Indexer, the Router, and the Replicator—to see what loads they exert on the server and how they affect user performance.

Consider your mix of user needs, probable hardware budget, and in-house expertise, and use our results as a guide to picture the general characteristics of your first—or next—Notes server.

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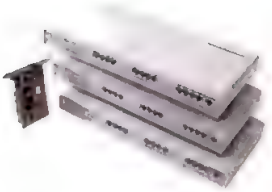

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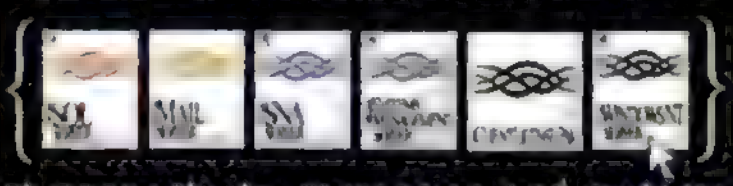

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Lotus Notes Server for Microsoft Windows NT

An apparent chip off of the old block, Lotus Notes Release 3.3 Server for Microsoft Windows NT is generally on a par with the OS/2 version—except that it performed somewhat better in our testing, especially on more CPU-intensive tasks. As good as that is, the real plus with Notes Server for NT is its painless networking configuration process. It far outclasses the other three Notes servers.

Notes Server for NT is the first Intel-based Notes server compiled as a multitasking 32-bit application. Although much of the code is still built around its 16-bit OS/2 sibling, it outperforms OS/2 when running some server processes. This server is the only PC-based version of Notes that supports more than one processor, a potential plus in running CPU-intensive Notes processes such as the Indexer.

Notes Server for NT exhibited a six fold improvement over the OS/2 version when running the server version of the Replication test. Similarly, Notes Server for NT's Indexer completed its tasks twice as fast as Notes Server for OS/2.

Client performance, however, was slightly slower than the OS/2 and—in some cases—the NetWare and Solaris versions. Notes Server for NT also suffered from a problem we saw in the OS/2 package: It could not maintain as many simultaneous connections as Solaris or NetWare.

The OS/2 server's problems in this area are attributed to its 16-bit architecture, but Notes Server for NT suffers from a coding bug, according to Lotus. This problem should be addressed in the next maintenance release.

Notes Server for NT benefits from many of Windows NT's features. Under Microsoft Windows NT Server 3.5, networking is a dream. There's no playing around with third-party drivers and networking software as with OS/2 or the less-than-intuitive network configuration stuff under NetWare.

While Notes Server for OS/2 supports all four Notes protocols—IP, IPX/SPX, NetBIOS, and AppleTalk—the Windows NT package supports only NetBIOS and IP. Nonetheless, because Windows NT is the only other platform to support NetBIOS, the NT and Notes server team makes for a painless change from existing OS/2 Notes servers.

Oddly, administration on the Notes Server for NT server is unnecessarily kludgy. You must bring down the Notes server to make any server configuration changes or perform local database administration.

New sites looking for OS/2-class performance should consider Windows NT. Existing OS/2 sites have less incentive to change.

Lotus Development Corp.

Lotus Notes Server for NetWare

Inheriting much from the OS platform, Lotus Notes Release 3.3 Server for NetWare exhibited good overall client performance and server processing. It supported more simultaneous users than its OS/2 and Windows NT siblings, and could be a useful general server for many sites. It is, however, more difficult to administer than some of the other platforms here.

This package is certified to run as an NLM with NetWare 3.11 through 4.01; we

LOTUS NOTES PLATFORM COMPARISON

	Installation	Administration	Networking	Database
Notes for NetWare 3.12	⊖ Requires a separate workstation to install software on the server. ⊖ Modifications to AUTOEXEC NCF must be made manually at the NetWare server console	⊖ Notes server must be down to use an administration client from a separate networked workstation ⊖ No server-based administration client at all.	⊕ A snap for NetWare folks. ⊖ Non-NetWare folks will find NetWare setup and protocol syntax confusing and arcane.	⊕ Supports a large number of users, but workstation latency is higher than with OS/2 and Windows NT versions ⊖ Processes such as UPDALL can completely consume server resources and thus freeze workstations
Notes for Microsoft Windows NT 3.5	⊕ Installs directly from the Windows NT server. Little tweaking is necessary	⊕ Can be installed as a Windows NT Service to allow many Notes administration functions to be performed remotely ⊖ Notes server must be down to run administration client on the Windows NT server or a networked PC	⊕ Windows NT's simple, built-in networking and graphical interface make it easy for everyone	⊕ Supports a large number of users while keeping up with server tasks
Notes for OS/2 2.2	⊕ Installs directly from OS/2 Presentation Manager. Little tweaking is necessary	⊕ Client on OS/2 server makes it possible to perform administration functions while server is up	⊖ A daunting labyrinth of confusing add-on software that's poorly documented, poorly supported, and difficult to install	⊕ Supports a large number of users while keeping up with server tasks
Notes for Sun Solaris 2.4	⊕ Installs graphically under Open Windows, much like the process on Intel-based platforms ⊖ In-depth knowledge of Unix is required	⊕ Client on Sun workstation makes it possible to perform administration functions while server is up ⊖ Server must be running under Open Windows to allow the administration client and server to run simultaneously	⊕ IP is already installed on Sun systems ⊖ Sun IPX/SPX services take a guru to install	⊖ Has serious problems supporting a large number of users who are simultaneously accessing a small number of databases ⊖ Workstation response is poor

Notes Powers Up with Release 4

The next version of Lotus Notes—Release 4, also known as *R4*—although focused on the developer and end user, is also expected to yield significant performance improvements at the server level. Scheduled to ship at the end of 1995, R4 will feature true 32-bit architecture, its most significant improvement. In its haste to get Notes up on a greater numbers of platforms, Lotus produced the current Windows NT, NetWare, and Solaris versions based on the 16-bit architecture of the original OS/2 app. R4 will finally be a 32-bit server from the ground up.

Improved support for symmetrical multiprocessing (SMP) is expected, the better for scalability, and R4 will add OS/2 to the list of versions that support SMP today. It also will increase the number of processors supported. The anticipated result of SMP plus 32-bit support is fewer R4 servers supporting a greater numbers of users.

Other improvements in server performance include the ability to run multiple, simultaneous replication tasks, reducing server-to-server or server-to-client replication times. A new database architecture will also help increase performance by allowing field-level replication.

Reducing server processor hits is the aim of other changes. Macros, called *agents* in R4, will be modified to give users greater control. Currently Notes must glean each database for macros periodically, a repetitive and arduous task for the server. The new agent management software will reduce the load by more intelligently tracking when and how agents should be run.—*TP*

tested it in the 3.12 environment. NetWare is a nonmultitasking environment, and Lotus uses a scheduling algorithm to simulate more closely the server running on a multitasking OS.

The Notes Server for NetWare console works nearly identically to the OS/2 console; you enter Show and other commands directly at the server. Note, though, that server configuration and database administration must be done from the network-connected PC. And the Notes server must be taken down to perform these functions.

During testing, this package exhibited some interesting tendencies. The time it took to complete the server versions of our Replication and Database tests, which stress indexer and replicator tasks, changed little, regardless of client load. It ran the server version of the Replication test in a speedy 2 minutes 30 seconds. The time to complete this task varied by only 47 seconds under a 120-client load. (Notes Server for OS/2's performance ranged from 6 minutes 27 seconds to 48 minutes 1 second.)

This behavior, however, sometimes resulted in poor performance for clients. During the Database test, the average task completion time was a minute longer than with OS/2 or Windows NT. We also attempted to run UPDALL, a comprehensive indexing task generally run in the wee hours of the morning. When we tried to login users at the same time they simply froze. NetWare is clearly less tolerant of unusually heavy server task loading.

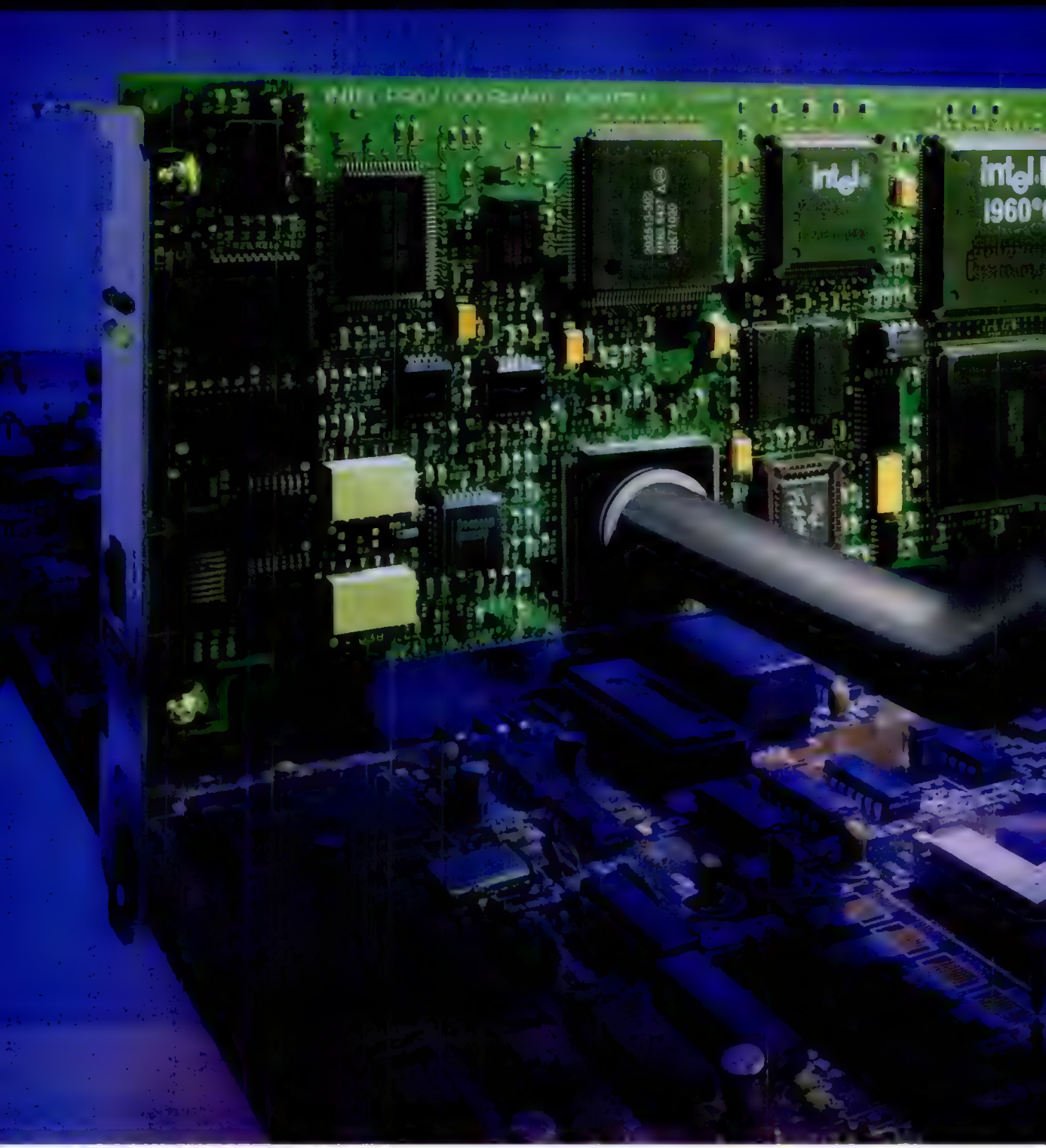
In general, Notes Server for NetWare seems excellent for supporting large numbers of users who aren't doing a whole lot—as long as there isn't significant server task activity, such as indexing large databases or volumes of databases. This actually fits the description of many Notes sites.

NetWare is familiar, and the idea of using the same folks who support NetWare file servers to support Notes servers is appealing. For organizations without NetWare expertise, however, its networking isn't nearly as intuitive as Windows NT's, and its interface and Notes administration are a pain.

	E-mail	Server replacement or addition	Other processes	Bang for the buck
	⊕ Supports more users than OS/2 and NT versions, but server tasks are frequently sluggish.	⊕ IPX/SPX protocols are already running on most client workstations. ⊖ Notes client still needs to change to NWSPX. ⊖ Available expertise is scarce, unlike OS/2	⊖ Few companion processes run on NetWare	⊕ Combination of platform and performance makes it a good buy. ⊖ NetWare five-user version adds approximately $700 to installation costs.
	⊖ Supports fewer users than NetWare and Sun Solaris versions.	⊕ Supports NetBIOS, which makes server replacement nearly transparent to users and IS departments. ⊖ Available expertise is scarce, unlike OS/2	⊖ Few companion processes run under Windows NT. But some run under Windows, which enables them to run under Windows NT	⊕ Combination of performance, platform, and operating system makes this a very good buy ⊕ No need for additional network software
	⊖ Supports fewer users than NetWare and Sun Solaris versions.	⊕ The legacy system most commonly installed ⊕ Expertise is readily available. ⊕ Simple to clone servers.	⊕ Most companion processes run on OS/2 servers.	⊕ Combination of performance, platform, and operating system makes this a very good buy ⊖ Networking software must be purchased

Lotus Development Corp.

Lotus Notes Server



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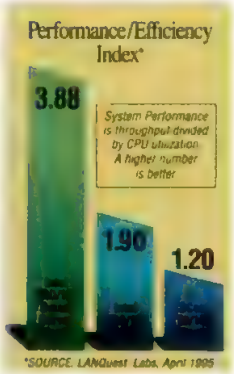

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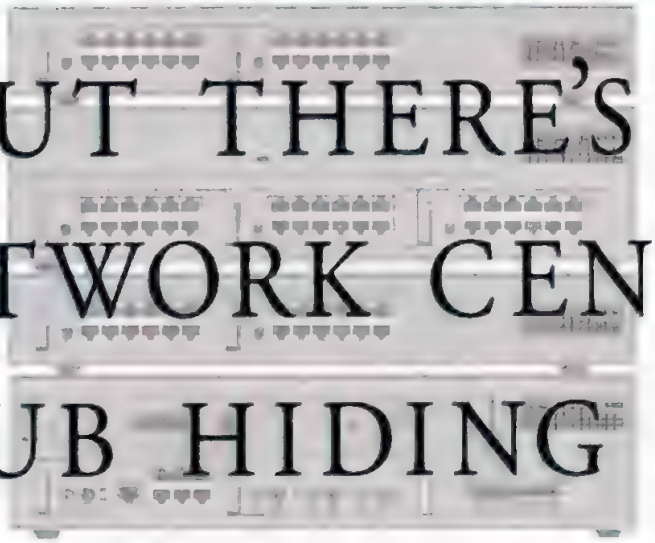

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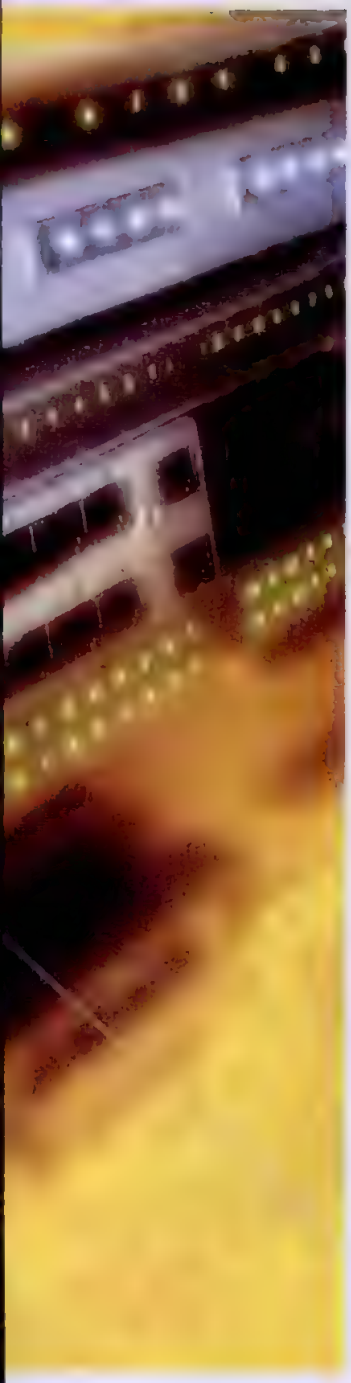

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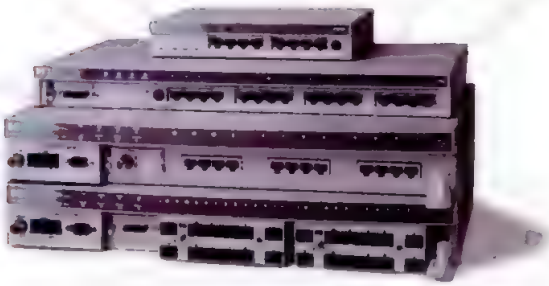


Server for OS/2 and the availability of third-party gateways and other processes written for this package still make it the most flexible version of all.

It does have a few drawbacks. Its networking processes continue to be a headache, and until Release 4 arrives, the lack of support for multiprocessing could hinder some companies from choosing OS/2 as their next platform for Notes.

Not yet certified for OS/2 Warp, the Notes Server we tested was for OS/2, Version 2.1. Networking isn't as integrated here as it is with Windows NT, so getting OS/2 onto your network takes some effort. Most existing Notes sites run the Novell OS/2 Requester for NetBIOS and IPX/SPX services along with FTP's or IBM's IP stack. Since you can't load both IP and IPX/SPX/NetBIOS reliably under the same NDIS or ODI stack, you generally must add a second adapter if you want to use IP or AFP with IPX/SPX/NetBIOS. Even so, Notes Server for OS/2 is the only package here that sup-

PERFORMANCE TESTS

Continues

Lotus Notes Servers

PC MAGAZINE LABS

OS/2 is no longer the only platform that can house your Notes server. The four platforms that we tested exhibited different strengths and weaknesses. Deciding which one is right for you means identifying your most important tasks.

What the Numbers Mean

During our testing, no one Lotus Notes server platform consistently outperformed its competition; a good mail server was not necessarily a good database server, and vice versa. When you choose a platform, therefore, you should carefully discern which tasks your users will perform most often and which will frequently be left on the back burner.

Many companies are even beginning to separate their e-mail and database operations onto specialized servers, rather than to sacrifice the performance of one or the other.

On the server version of our Mail test, Lotus Notes Server for Sun Solaris 2.3 and 2.4 handily outperformed its siblings. It could handle a much larger client base than either the OS/2 or the Windows NT version and was never caught with a preponderance of unrouted messages. As a database server, however, the Solaris server was by far the most disappointing platform; not only was it slow to replicate and index databases, but it often brought down the server when under the strain of a large user load.

Lotus Notes Server for NT and for OS/2 turned in similar numbers on all of our tests. They filled the top two spots on both versions of our Database test and traded second-place finishes on both versions of our Replication test. If you are looking solely for a mail server, however, you'll be better served elsewhere; these two platforms were always the first to crash under heavy mail traffic.

Lotus Notes Server for NetWare exhibited steady overall performance. It supported a large number of both database and mail users but tended to forfeit user performance during database indexing and exhibited slow mail routing when more than 75 users were attached.

How We Tested

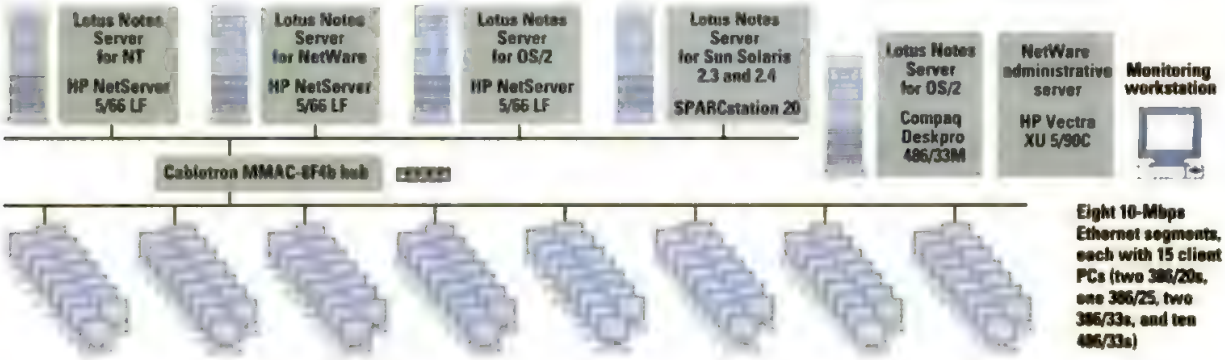
To simulate a large Notes environment, we networked a test-bed of 120 client PCs running Microsoft Windows for Workgroups 3.11 and Lotus Notes Release 3.3 Client. As Lotus recommended, we left all NOTES.INI parameters at their defaults except where noted.

On the server side, we tested Lotus Notes Server for NT, for NetWare, and for OS/2, each on its own single-Pentium HP NetServer 5/66 LF running the appropriate OS. Each of the three machines was configured with 128MB of RAM, four 1GB hard disks, and an Eagle NE-3200 EISA network adapter. To test Lotus Notes Server for Sun Solaris 2.3 and 2.4, we used a Sun SPARCstation 20 with 5GB of hard disk space and 128MB of RAM. This system was equipped with Sun's quad Ethernet adapter and two processors, although we disabled one processor for most of the testing.

All systems were connected on the same LAN, with clients and servers separated on their own Ethernet segments. As for network protocols, we observed little variation between our IPX, IP, and NetBIOS test results. For consistency, all of our test results are based on IP testing.

We also attached two additional servers to the test-

Lotus Notes Server Test-Bed



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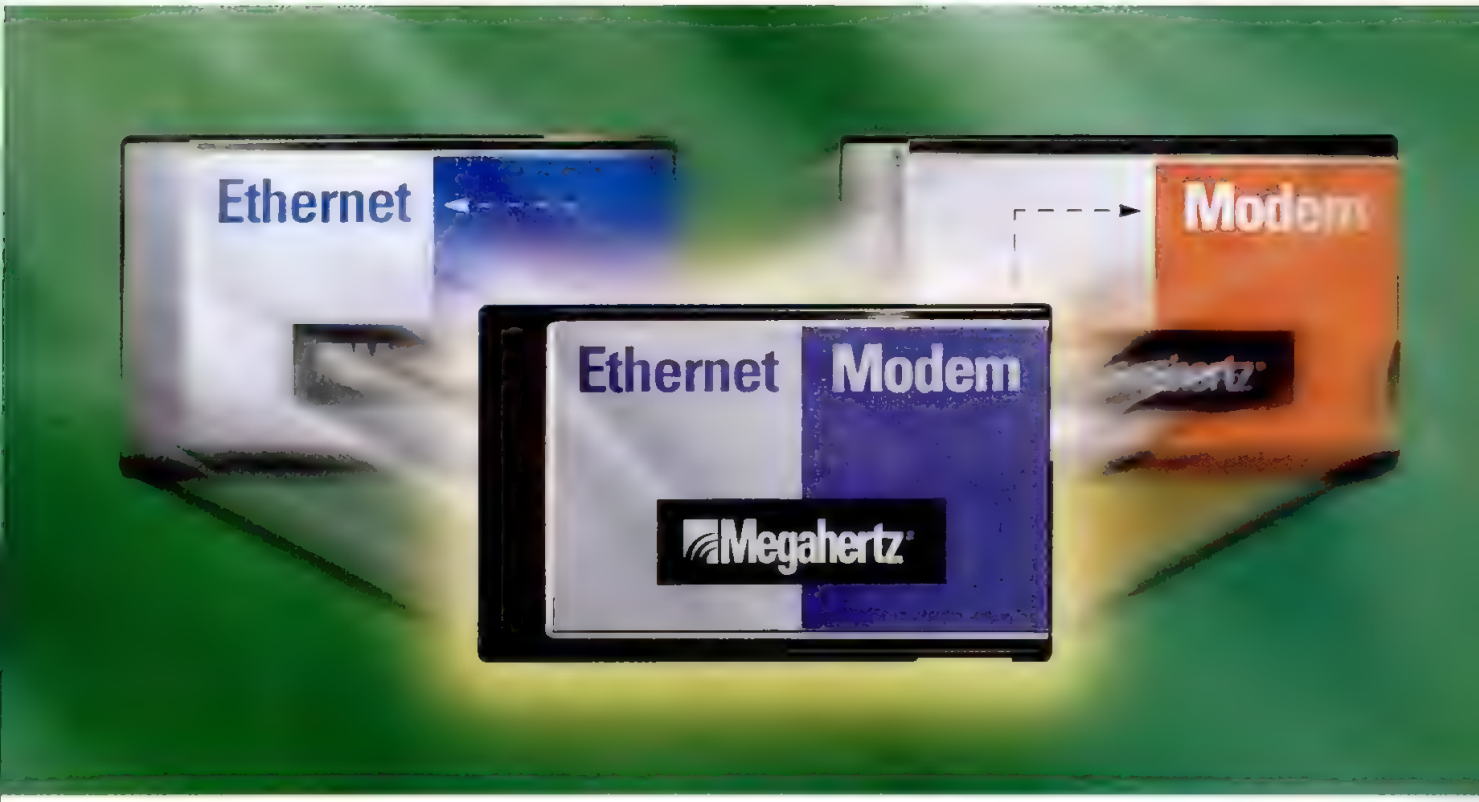

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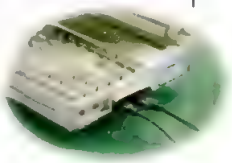

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CIRCLE 896 ON READER SERVICE CARD

ports the gamut of protocols: IPX/SPX, IP, NetBIOS, and AFP.

During our testing, Notes Server for OS/2 firmly defended its lead position. Like Notes Server for NT, it did best on the Replication and Database tests. It consistently offered some of the best client performance, with reasonable attention paid to server processes as well.

Also like the Windows NT product, it did not function quite as well as a mail server. We typically saw memory errors on the server during Mail tests as we exceeded 60 users. Lotus attributes the memory limitations to the 16-bit architecture. The OS/2 product edged out Notes Server for NT in client performance—outperforming it at the key high end of our 120-node loading scale.

This is still the easiest server to administer as well. The Notes client can be run directly from the server, making it simple to perform local database administration and modify server parameters. Also, because

bed: a fifth server—running Lotus Notes Server for OS/2 and used only for database replication—and a NetWare administrative server that collected workstation and test status information while storing common files such as those comprising server IDs, address books, and user mail databases.

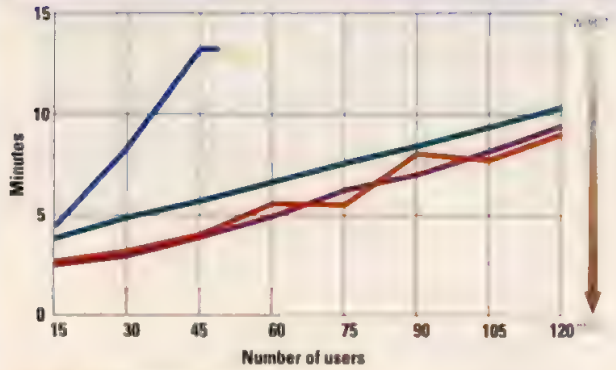
We ran each test initially with a base of 15 clients; we then repeated the test, adding clients in increments of 15. We halted testing when the server was brought down or the number of users reached 120.

Server-side testing required no additional evaluation software. The results of our **Replication** test (not shown), which measures the amount of time needed to replicate a single database, and our **Database** test, which measures the amount of time needed to index a single database, are lifted straight from counters in the Lotus Notes Server software. The **Mail** test measures the number of unrouted messages remaining on the server after several mail tasks are performed by each client.

Client-side testing utilized a *PC Magazine*–developed program that simulated loads relevant to the processes and server types being tested. We created the test program, as well as a client-control and -monitoring program (run on a separate workstation), with Microsoft Visual Basic. The **Replication** (results not shown) and **Database** tests, running the Notes replicator and indexer, respectively, each measure the time it takes clients to complete a series of reads, writes, and view changes; each client performs its tasks on one of four different databases. During the **Mail** test, each client again goes through the same series of tasks while accessing its own mail database.

Notes Server for NT — Notes Server for NetWare — Notes Server for Sun Solaris — Notes Server for OS/2

DATABASE CLIENT



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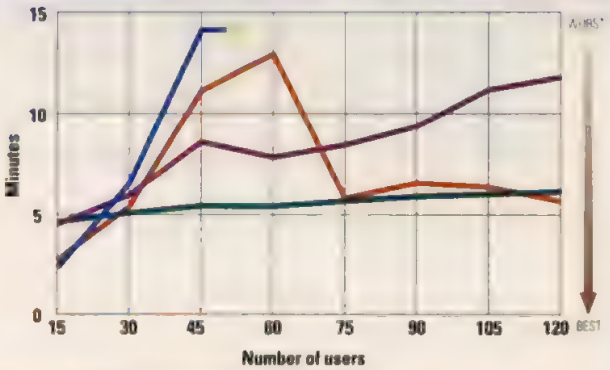
DATABASE SERVER



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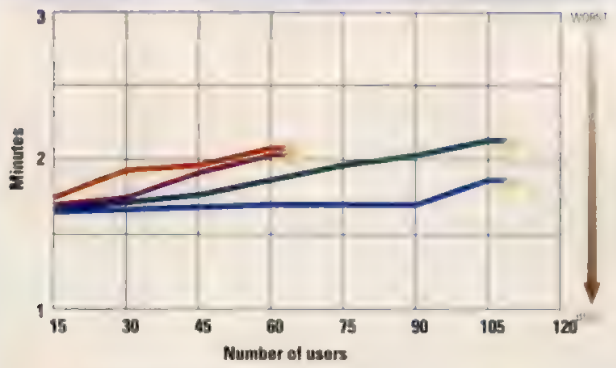
MAIL CLIENT



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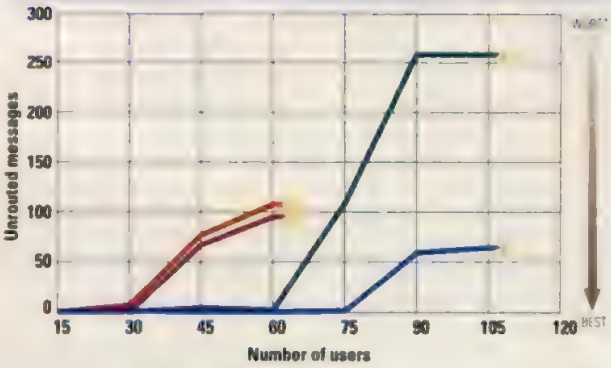
MAIL SERVER



Fail: The product could not complete this test

Fact File

Lotus Notes Release 3.3 Server for Microsoft Windows NT, for NetWare, for OS/2, and for Sun Solaris 1.1, 2.3, and 2.4.
Lotus Notes Release 3.3 Client for AIX, for HP-UX, for Macintosh, for Microsoft Windows, for OS/2, for SCO Open Desktop, and for Sun Solaris 1.1, 2.3, and 2.4.
List price: $275 per client or server; Desktop, $155 per user in quantities of 50 users; Express, $99 per user in quantities of 100 users; Starter Pack, $995.
Lotus Development Corp., Cambridge, MA; 800-343-5414, 617-577-8500; fax, 617-693-3512; Web, http://www.Lotus.com.
Circle 952 on reader service card

Notes Server for OS/2 was long the only game in town, most companies with add-on products have written to it.

For existing sites, Notes Server for OS/2 is hard to beat. It's got the only real track record, there's a great deal of expertise out there, and the number of add-on processes is overwhelming. New sites should look at this package and the one for Windows NT. Notes Server for NT offers comparable performance, easier networking, and better scalability in the form of support for SMP.

Lotus Development Corp.

Lotus Notes Server for Sun Solaris 2.3 and 2.4

Powerful, with scalability galore, Lotus Notes Server Release 3.3 for Sun Solaris 2.3 and 2.4 will nevertheless be a stretch for most support teams and IS budgets. In addition, our testing turned up some serious shortcomings when this version is used as a database server.

We tested Notes Server for Sun Solaris on a Sun SPARCstation 20. The server can support as many as eight 75-MHz processors. We performed the majority of our tests with a single processor, but test trials with multiple processors showed that Notes server tasks and client performance could both benefit from the addition of even a second CPU.

A Sun spokesperson points out that Lotus uses a somewhat inefficient method of implementing Notes—by spawning *processes* rather than *threads*. This forces Solaris to consume more resources and memory than would be necessary with threads. Lotus says it recognizes this shortcoming in the Sun version and is investigating the use of other coding methods for Release 4.

During our testing, Notes Server for Sun Solaris outperformed the other versions in supporting mail users. We were able to support 105 mail users with very little degradation in client performance or rise in server tasking. The 105 ceiling is confirmed by Lotus: Notes does not allow sup-

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port for more than 105 active databases open simultaneously.

On the server version of our Database test, Notes Server for Sun Solaris took a nasty turn, supporting the smallest number of clients and producing server errors with only 45 users. This is an unfortunate shortcoming, one that Sun is looking into.

Another thing to consider is that most folks accustomed to PC-based operations will need a Unix hired hand to help with Sun workstation configuration and Unix user and group configuration. That said, once we got the Unix side of things set up, installation was identical to that of the other packages. The Sun Open Windows graphical interface will be familiar to veterans of OS/2's Presentation Manager, Windows, and Windows NT. Running the server in Open Windows lets you initiate other tasks, but it degrades performance.

Sun's IPX/SPX services make it possible to connect PCs without having to load an IP stack (the standard network protocol for Unix servers) on user systems. Again, installing these services is a task for a Unix guru.

This is a very different beast to install and manage, and the hardware is much more expensive than a similarly configured PC. We'd keep an eye on Solaris, though, especially if Notes 4 lives up to its claims of greater capacity. □

Notes on Networking

In *PC Magazine* testing, we observed that Notes' performance varied little whether run over IP, IPX/SPX, or NetBIOS. As a client/server application, Notes produces very little network traffic. But there are other considerations when choosing a protocol. NetBIOS, the most prevalent by default, is efficient in smaller networks, but its broadcast, nonroutable format results in a large amount of network traffic.

IPX/SPX is more efficient, and it's routable, but it carries overhead. Still, Notes on NetWare would be a relatively easy install for the shops that already run NetWare.

TCP/IP is gaining popularity. You can send large amounts of data with far fewer packets, which is especially good for WANs. TCP/IP can coexist with IPX and NetBIOS using NDIS or ODI stacks. For users and servers to locate Notes servers, you need a Domain Name Service with the entry of each server name on the server.

For remote access, many companies opt for Notes' built-in XPC support for dial-up. Other options include remote-node products such as IPX/SPX/NetBIOS (supported by Techsmith) or IP products such as Chameleon.—*TP*

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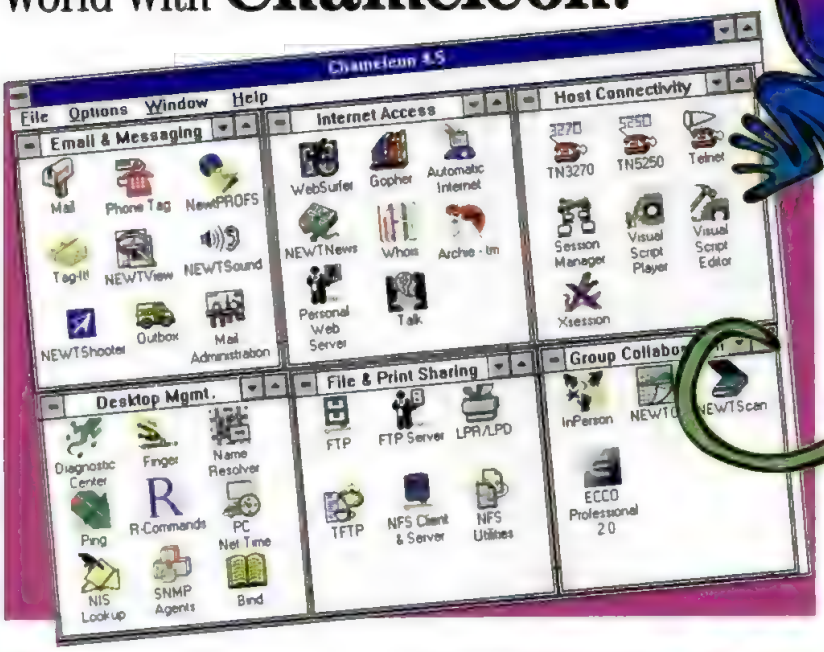

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CIRCLE 877 ON READER SERVICE CARD

First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

GROUPWARE

Give Your Office a High IQ

By O. Ryan Tabibian and Robert P. Lipschutz

Do you need to share all of your documents and organize them along with your workflow processes and workgroups through a friendly graphical interface? If so, then you might want to look into Office.IQ, Version 2.1, from Portfolio Technologies. This Microsoft Windows–based product can be used for all of the above on a NetWare 3.*x* or 4.*x* network, although it can be rather complex and difficult to learn. If you're willing to invest the time in user training, however, Office.IQ can do wonders for organizing your network.

Office.IQ ($2,475 for five users) includes both client and server software. While the installation of the client software was relatively simple, we ran into a few glitches with the server installation due to conflicts with the version of Novell's Virtual Loadable Module (VLM) client drivers we were running (Version 1.2). After a call to technical support we were able to resolve the problem by deleting a duplicate .DLL file the application was attempting to call.

AT THE DESKTOP

From the client, you can create or edit workflow processes and folders for organizing your workgroup and your vital documents. Within each workflow, you can create a graphical map of users and groups and then link these groups and share information between them. For example, you can click on a user's icon, drag it into the workflow, and link that user to the group.

That user will now be able to share and exchange documents with the rest of the group. Also, to forward a document to another user, you can simply drag and drop that document from its folder to the destination user's icon in the workflow.

The documents available to your workgroup can be from virtually any Windows-based application. Support for several file formats, such as Microsoft Word .DOC and Lotus 1-2-3 .WKS, is built into Office.IQ. Other file types can be imported through Office.IQ's import feature and shared by the workgroup.

BEHIND THE SCENES

The server portion of Office.IQ is an NLM that runs on a NetWare 3.*x* or 4.*x* server. The NLM is loaded and managed from a Windows client, however. From this centralized administration console, you can add users, create replicated databases, and manage multiple databases. Adding users was the easiest part of the process, since Office.IQ reads the user information directly from the Bindery.

To save network disk space, Office.IQ saves only a single copy of any one document. So even if links to a document exist in multiple workflow processes, only one copy of that document actually resides on the network. This is also helpful for protecting access to documents, since Office.IQ locks that single copy to ensure that only one user has access to a document at any given time.

For wide-area connectivity, Office.IQ includes a Lotus Notes–like replication feature and support for Novell's Message Handling System (MHS) e-mail system. The replication feature allows you to grant users at different network sites access to a specific workflow, document, or folder. Support for MHS allows Office.IQ users to send e-mail from within the Office.IQ application. Unfortunately, Office.IQ does not support either VIM or MAPI e-mail systems, so users can send mail only to other Office.IQ users or other users equipped with MHS e-mail front-ends.

Office.IQ, Version 2.1. *List price: For a five-user license, $2,475. Portfolio Technologies Inc., Newark, CA; 800-626-7711, 510-226-5600; fax, 510-226-8182.*

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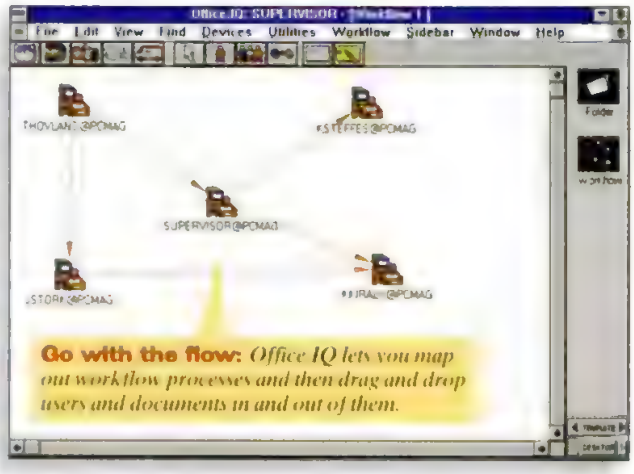
Office.IQ



Go with the flow: *Office IQ lets you map out workflow processes and then drag and drop users and documents in and out of them.*

REMOTE ACCESS

Digital Joins the Remote Crowd

By Steve Rigney

If you're looking for an inexpensive remote-node server for your TCP/IP network, Digital Equipment Corp. may have the perfect solution for you: the NetRider 90 M. But if you need dial-out capabilities or want to take advantage of the latest V.34 modems, you should look elsewhere.

The $3,400 NetRider 90 M is a tiny box (11 by 5 by 1 inches) that includes eight serial ports and all the software you need to establish remote-node and remote-control connections to your host network. Unlike the Shiva LANRover (reviewed in Network Edition, June 13, 1995) and the Microcom LANexpress, the NetRider 90 M requires you to supply your own modems. The bundled remote software—Stampede's Remote Office Gold 2.0—allows you to establish a dial-up connection using the IPX, NetBEUI, and TCP/IP protocols. The NetRider 90 M can also act as a terminal server for connecting serial terminals to your mini- and mainframe computers, making this

Continues on page NE28

NETWORK BACKUP

NT Backup Without the Frills

By Steve Rigney

Until now, your only options for backing up a Microsoft Windows NT Server network were Windows NT's built-in backup utilities and Arcada's BackupExec for NT. Backup veteran Cheyenne Software brings you a third option: ARCserve for Windows NT, Version 1.0.

ARCserve for NT ($895) provides an excellent user interface and powerful security along with a host of useful features like job scheduling and the ability to access multiple tape devices simultaneously. If you need remote management features or the ability to back up different operating systems, however, you should consider BackupExec ($695 for the single-server version or $1,295 for the Enterprise Edition) or sit tight and wait for Cheyenne's next release.

IN ACTION

We installed ARCserve for NT on a Zenith Data Systems Z-Server EX P90E equipped with a MaynStream 4000 DAT (attached via an Adaptec SCSI controller) and running Windows NT Server 3.5. We performed a full server backup and we also connected to and backed up a Windows 95 peer-to-peer server and a NetWare server across the network. While the backup performance was acceptable (approximately 18MB per minute), we had to wait about 10 minutes after each backup set for ARCserve to write the information to its internal database. In some cases it took longer to create this database than it did to perform the backup.

Like ARCserve for NetWare—Windows Edition (see "Flexing Your Backup Muscle," Network Edition, June 13, 1995), ARCserve for NT includes two key technologies: parallel streaming and cascading. These allow you to use multiple tape devices during a backup or restore procedure simultaneously. Parallel streaming allows you to perform several different backup jobs to different tape devices at the same time. Cascading allows you to back up to multiple tape devices that are installed on different SCSI controllers in your server.

ONE-ON-ONE WITH THE EXEC

The biggest advantage ARCserve for NT has over BackupExec for NT is its extremely easy-to-use interface. Here, ARCserve for NT closely resembles ARCserve for NetWare—Windows Edition. ARCserve for NT's Quick Access utility allows you to start a backup or restore, view the status of a job, and generate a report all from a single menu. All of the ARCserve menus include context-sensitive help and Cheyenne provides updated help files free of charge on its technical support BBS (516-484-3445).

Although more expensive than the basic BackupExec package, ARCserve for NT allows you to back up an unlimited number of Windows NT servers with a single-user license of the software. With a single-user license of BackupExec, you can back up only a single Windows NT server. To back up multiple servers with BackupExec, you need the more expensive Enterprise Edition.

Reporting is another one of ARCserve for NT's strong points. In addition to reports on all of your backup and restore jobs, ARCserve for NT can also report on the status of your hardware, such as the last time you cleaned your tape drive. BackupExec's reporting features, on the other hand, are limited to backup and restore operations.

In terms of media, both ARCserve for NT and BackupExec for NT work with most 4-mm and 8-mm DAT drives, as well as QIC tape devices. Both products also work with tape auto-changers—but only with additional software ($595 for ARCserve, $495 for BackupExec).

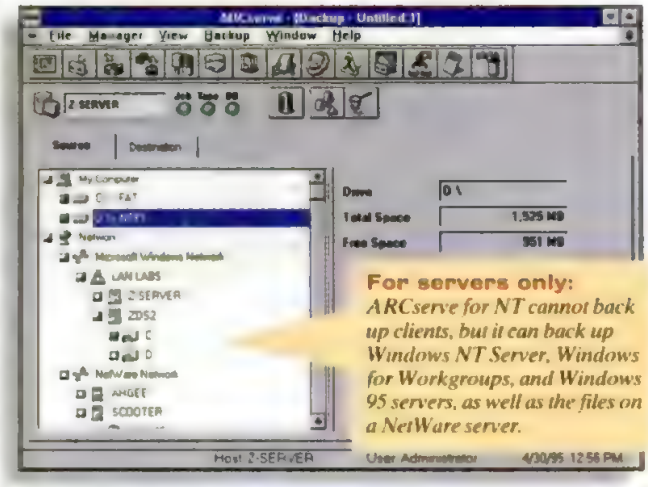
Unlike the backup utility included with Windows NT Server, ARCserve and BackupExec both run as 32-bit Windows NT system services—not as applications. The ability to run as a system service can enhance performance and allows you to launch a scheduled backup job without first logging on to the server. A system service also requires less memory than an application.

Unfortunately, ARCserve for NT does not provide any agents that allow you fully to back up PCs running OSs other than Windows NT. To back up a non–Windows NT PC through ARCserve for NT, that PC must be configured as a server and your Windows NT server must be able to connect to it. Even when these PCs are servers, however, ARCserve for NT is limited. For example, we backed up the files on our NetWare server with ARCserve for NT, but since the product does not support a NetWare server agent, we could not back up the Bindery information.

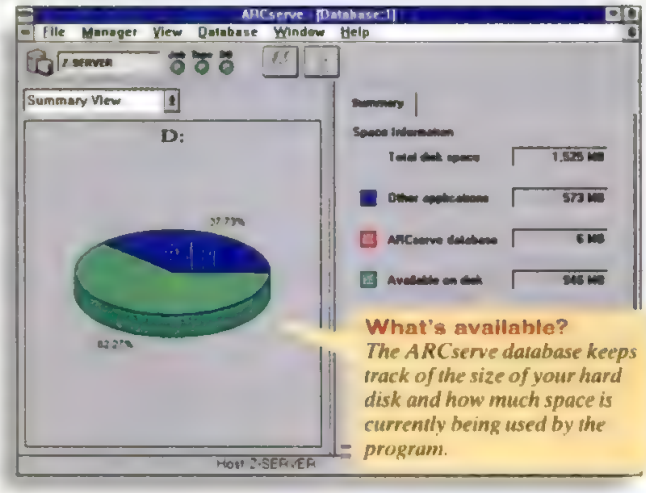
BackupExec, on the other hand, can work with agents to back up all of your DOS, Macintosh, Windows, Windows 95, Windows NT, OS/2, and Unix PCs through the Windows NT server. ARCserve for NetWare also supports agents for a wide

Continues on page NE28

ARCserve for Windows NT



For servers only: *ARCserve for NT cannot back up clients, but it can back up Windows NT Server, Windows for Workgroups, and Windows 95 servers, as well as the files on a NetWare server.*



What's available? *The ARCserve database keeps track of the size of your hard disk and how much space is currently being used by the program.*

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Quality, Support and Reliability

Cheyenne

Continued from page NE26

variety of operating systems.

Another important feature missing from ARCserve for NT is the ability to monitor and control all of your backup servers from a central location. While this is not important if you only have one server, it can save you a lot of time if you have multiple servers stretched across a large LAN or WAN. BackupExec includes a remote-control and monitoring utility while Cheyenne hopes to include one in the next release of ARCserve for NT.

ARCserve for Windows NT, Version 1.0. *List price: $895. Cheyenne Software Inc., 3 Expressway Plaza, Roslyn Heights, NY; 516-484-5110; fax, 516-484-3446.*

Circle 951 on reader service card

Digital

Continued from page NE25

product a perfect fit for many existing Digital customers who need to add remote-access and telecommuting capabilities to their networks.

SETTING UP

The NetRider 90 M hardware was easy to install. The unit can stand alone or fit into a Digital DEChub concentrator chassis. The software, on the other hand, took some time to configure. This was due primarily to the fact that we installed the NetRider 90 M on a NetWare 3.12 LAN running IPX, but the unit can only be configured using a TCP/IP connection or a direct connection using telnet. After we successfully installed the TCP/IP drivers on our management console, we were able to communicate with the server and set up user names, protocols, and modems.

To configure the unit over a TCP/IP connection, you can use either the included Windows-based utility or any telnet package for a terminal connection.

On the client side, the bundled Remote Office Gold client software allows you to establish both remote-node and remote-control connections through the NetRider 90 M. Remote Office Gold also lets you create Windows icons that will automatically establish a connection and launch an application on the remote network.

A FEW CAVEATS

The NetRider 90 M is not without its faults. It lacks network dial-out capabilities and high-speed serial ports. The serial ports are limited to dial-in speeds of 57 Kbps; most V.34 28.8 Kbps modems can reach speeds of 115.2 Kbps with compression. Fortunately, higher-end NetRider models, such as the 32-port NetRider 900 ($9,435), offer high-speed serial ports. Other products, including the LANexpress and the LAN-Rover, offer both network dial-out and higher access speeds.

In terms of management, the NetRider 90 M includes software for tracking user and port statistics, but it does not provide a built-in audit utility for generating detailed reports. For more in-depth statistics gathering, you will want to invest in an SNMP management console, such as HP OpenView.

NetRider 90 M. *List price: $3,400. Digital Equipment Corp., Maynard, MA; 508-493-5111; fax; 508-493-8780.*

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THE NETWORKER By Diane Danielle

Dangers of the Desktop

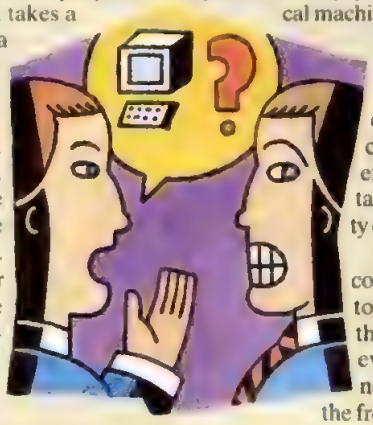
At a recent meeting of the San Francisco NetWare Users Group, an attendee asked us to recommend a desktop computer. What followed was a litany of bad experiences from consultants, contractors, integrators, and managers of corporate networks.

Dell? Richard Retin said the company was reliable, but because Dell builds to order, it takes a minimum of two weeks to get a computer for a new employee. Worse, although Retin has been buying the same model for more than a year, they aren't the same inside. When some application or system won't run, he has to track down component-level revision differences.

Compaq? IBM? AST? Gateway? All have increasingly short development cycles, so the model you buy today may be gone tomorrow.

Some manufacturers sell on-site service for one to three years. But these warranties are often voided if you add any third-party components to the chassis or even, in some instances, to any of that vendor's own components. One buyer said he was covered if he bought components from one division of the manufacturer but not if he bought them from another division.

Although the people were buying computers from every major manufacturer and not a few of the mail-order companies, nobody wanted to make a recommendation.



I know the feeling. I dread having clients (let alone friends) ask me what they should buy, because I know that sooner or later something won't work right. I certainly don't want vendors to stop improving their products or fixing bugs, but I do think we'd all benefit from longer development cycles and better testing. In the meantime, what can we do?

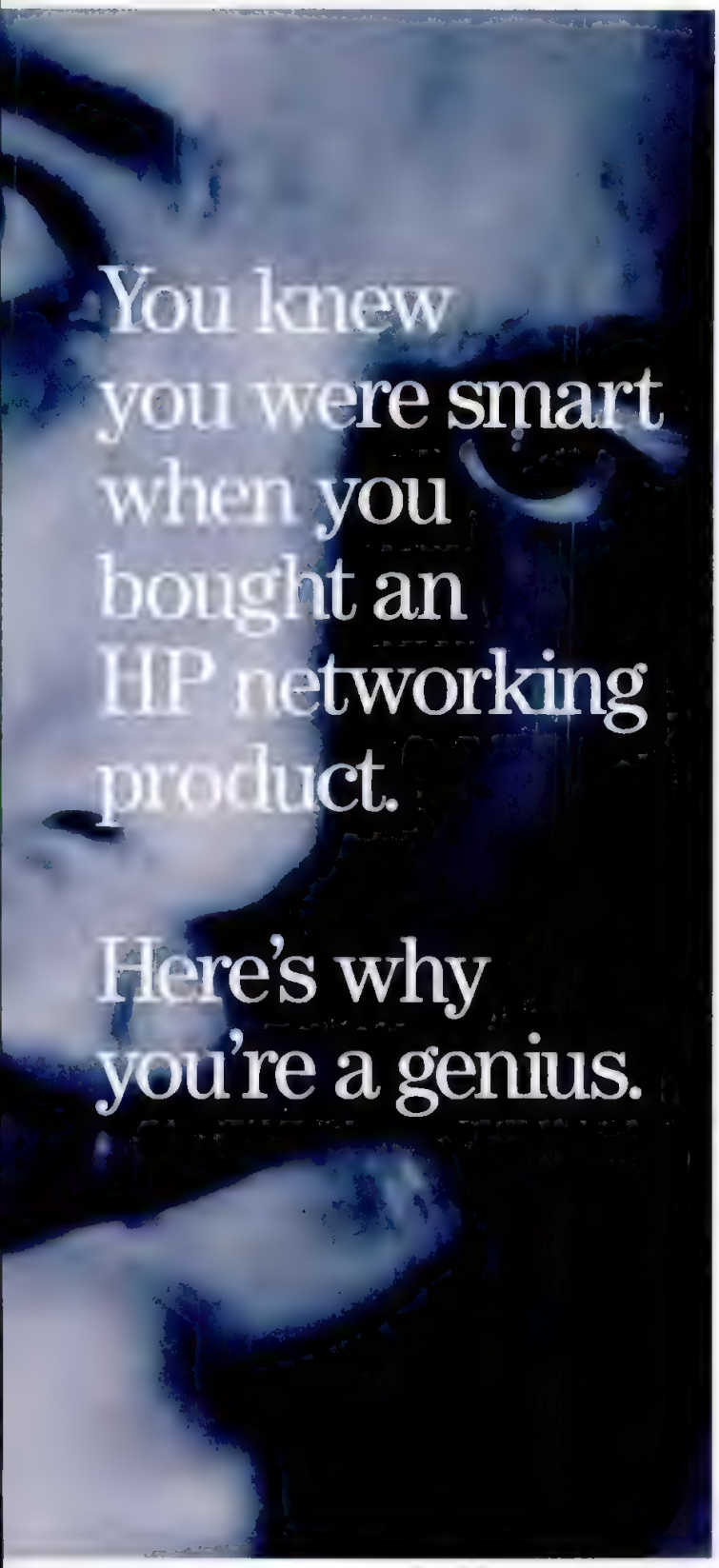
To minimize rev-level changes, group your purchases and buy late in a model's life cycle. One member suggested buying a year's worth of computers at one time and stuffing them with everything the vendor offers that could possibly be needed in the succeeding three years, including extra memory and disk space. This way, you have a fighting chance of getting identical machines with components.

The downside to this strategy is obvious. You don't get to ride the price-performance curve or take advantage of staggered depreciation cycles. And you'll be buying more computer than you need. But since the most expensive part of buying a computer is maintaining it, this strategy does offer the possibility of minimizing ongoing costs.

Add the part number and rev level of every component in each computer to your inventory. If you have a regular integrator, insist that the integrator ship this information with every machine. Lastly, when you do your next desktop computer evaluation, include the frequency of model and component changes in your criteria and make sure the vendor knows how important product stability is to you.

Diane Danielle, an independent networking consultant, can be reached on CompuServe at 72241,2566 or MCI Mail at 383-1159.

Illustration by Dave Black



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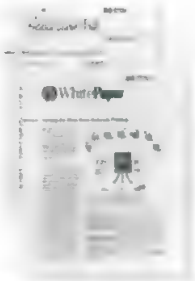

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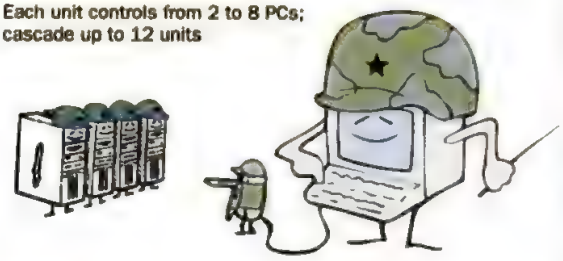

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"The Envoy is a terrific piece of engineering, and the wireless link puts it miles ahead of anything else in its class."
Network World [3.13.95]
"With its integrated wireless capability, Marco clearly outshines the rest."
-8-wireless
8 9 4 7 3 5 3

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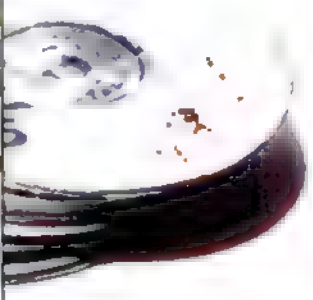
- SCSI II connection
- Optional SCSI II bay for additional hard drive



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PC MAGAZINE EDITORS' CHOICE
August 1994
TM4000M/25

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July 1994

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CIRCLE 304 ON READER SERVICE CARD

THE TOP 100 CD-ROMs

Here they are: the hottest new multimedia titles of 1995. Curious to see which disks caught our eye? Turn the page and take a spin.

By Lance Ulanoff

Illustrations by Jesse James Doquilo /Studio MD

When you look at the shiny surface of a CD-ROM, do you see yourself? You ought to, because in their proliferation, these multimedia marvels reflect our basic desire to be educated, entertained, and enlightened in compelling new ways. Multimedia developers and publishers have rushed to fill our seemingly insatiable need for multimedia with an ever-growing number of CD titles. According to InfoTech (a Woodstock, VT–based market-research firm), 1994 sales of CD-ROM drives built into new PCs outpaced those sold in multimedia-upgrade kits by a 2-to-1 margin.

No wonder the number of CD-ROM titles catapulted to nearly 10,000 this year. Experts say, though, that while the overall number of CD-ROM titles will continue to grow, the pace is sure to slow down, and the number of publishers is certain to shrink.

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Does that mean that users are tiring of CD-ROMs already? Hardly. Through a Darwinian process, publishers—some of whom occasionally produce weak titles full of public-domain material—are falling away and leaving behind a smaller group of multimedia-savvy developers. Of course, some of *them* are also disappearing or cutting back on title production. But that's more a result of over-reaching ambitions colliding with the reality of release schedules and returns on investment (some of the best titles cost upwards of $1 million to produce) than a result of shrinking market demand.

This natural market contraction didn't make the task of selecting the top 100 CD-ROMs now available any easier than it was last year. There were still thousands of published titles to sift through. To bring the list down into the hundreds, we evaluated only titles that were released after September 1, 1994.

To make *your* job easier, we've sorted our top 100 into six groups.

- You'll find all types of business-enhancing multimedia in our **Office** section, including tools to help you do your job better (such as typing instructions and phone directories for the entire country).
- **Reference Shelf** is where you'll find dictionaries, encyclopedias, and other information-rich titles.
- We placed home improvement, gardening, and leisure activities such as travel planning in our **Home** category.
- Kids' games—both the just-for-fun and the educational kind—can be found in **The Kids' Room.**
- Our **Rec Room** selection includes the hottest games and other forms of entertainment with little or no (intended) educational value.
- Our **Coffee Table** CDs are multimedia titles that would also make wonderful, large-format, hard-cover picture books. Within each category, the CD-ROMs are ordered alphabetically by title. The top 100 titles are bold-faced throughout so you can spot them more easily. And in some cases, we counted two similar products from the same company as one.

Thirty-eight *PC Magazine* staff members looked at hundreds of CDs and rated them based on criteria such as content, multimedia innovation, resource requirements, interface, and overall impression. They also waxed rhapsodic on each and every one, detailing their likes and dislikes. Their critiques make up a litany of multimedia angst and *amore.*

In the course of this exercise, we gathered quite a few interesting and useful CD-ROM information tidbits. Those little facts—we call them *Quick Spins*—run across the bottom of the following pages. The top-100 list, in its entirety, appears on the three final pages of this story. Use it for quick reference when you go shopping for your own CD-ROM collection.

FEATURES PLUS

From June 12 to 16, go on ZiffNet to discuss the best CD-ROMs with the companies who created them. Type GO EDITOR from any CompuServe ! prompt. Also download the 100 CD-ROM reviews in this feature in a searchable Windows Help format from ZiffNet (GO EDITOR and search on filename CDR100.ZIP) or from the World-Wide Web at http://www.ziff.com/~pcmag

QUICK SPINS

The CD-ROM Market

- The Top-Selling CD-ROMs of 1994, according to the market-research firm PC Data, were:

1. Myst (Brøderbund Software)
2. Doom II (GT Interactive/Id software)
3. 5ft. 10 PAK, Volume 1 (Sirius Publishing)
4. Star Wars Rebel Assault (LucasArts Entertainment Co.)
5. The 7th Guest (Virgin Interactive Entertainment)
6. Microsoft Encarta (Microsoft Corp.)
7. Disney's Animated Storybook: The Lion King (Disney Software)
8. Print Shop Deluxe CD Ensemble (Brøderbund Software)
9. Quicken CD-ROM Deluxe (Intuit)
10. Corel Gallery (Corel Corp.)

- Games make up the most popular CD-ROM category, followed by arts and enter-

Illustrations by Timothy Carroll

For the OFFICE

We're all familiar with the usual office tools, but only CD-ROMs can bring information and automation to your workplace without crowding your desk or cluttering your mind.

Until now, most of the musical accompaniment you could add to your presentations ranged from the banal to the simply annoying. Cambium Development's **Cambium Sound Choice,** Volume 2, $69, changes all that. With its sweeping orchestral arrangements, hard-edged rock (no vocals), and smooth jazz rhythms, it raises the state of the art of business sound clips to a whole new plateau. The volume includes 29 clips, each about 60 seconds long, that range from rock to classical. All are original recordings. You can copy any of the selections to use with your presentations or just enhance your desktop activities.

In addition to the minute-long clips, Sound Choice includes short "bumpers," or snippets of the longer clips, which last anywhere from 4 to 15 seconds. These can be easily applied to transitions or used as finales and stingers. Using the simple Windows interface, you can fade any of the longer selections by specifying where they end and the duration of the fade-out. At maximum quality, clip file size tends to be large. Thankfully, you can reduce the file size without radically reducing the quality of the clips.

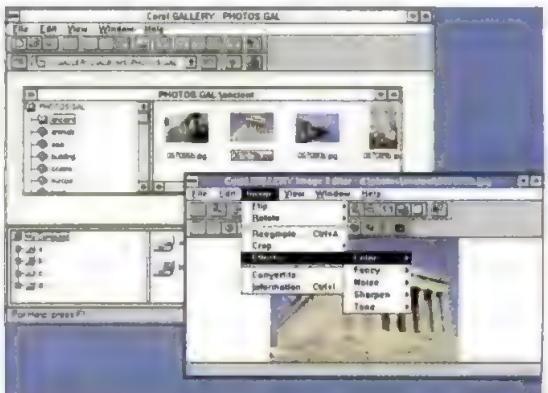
With 50 percent more clip art than its predecessor, plus 500 photos, 500 fonts, and sound and video clips, Corel Corp.'s **Corel Gallery 2,** $99, is a treasure trove of ready-to-go artwork for your business presentations, letters, reports, and other output where a picture is part of the formula for successful communication. Corel has provided a logical tree-structured index of the categories of art and other files available, plus thumbnails of each image to assist browsing and selection.

The scope of Corel Corp.'s **Corel Stock Photo Library**, $995, is truly amazing. Available as a Windows/Macintosh hybrid, it offers 20,000 royalty-free photographs on more than 200 topics, a full-color reference manual, and the Corel Art Show 5 book. If you still can't find that perfect photo, Corel throws in a book and a CD-ROM entitled "The World's Best Digital Photographs," which contains 120 royalty-free high-resolution photographs.

Hewlett-Packard's **HP Support Assistant**, $395 for one year, is a subscription service that can give your corporate help desk or technical department an all-in-one source for technical information on a whole range of HP products. It includes up-to-date data on HP's line of printers, servers, PCs, and network products.

Updated monthly, the Assistant is designed as a hypertext help system, with a What's New section that's categorized by product. A search window lets you find specific topics by keyword, spanning some or all of the product categories. Information ranges from installation directions to specific API calling syntax on the HP/GL language.

Microsoft Developer's Network CD, $195 for Level I and $495 for Level II, is a must-have for programmers working with Microsoft developer tools. Containing an overwhelming amount of informa-



Corel Corp.'s Corel Gallery 2 provides a wealth of clip art, photos, and sound and video clips.

QUICK SPINS

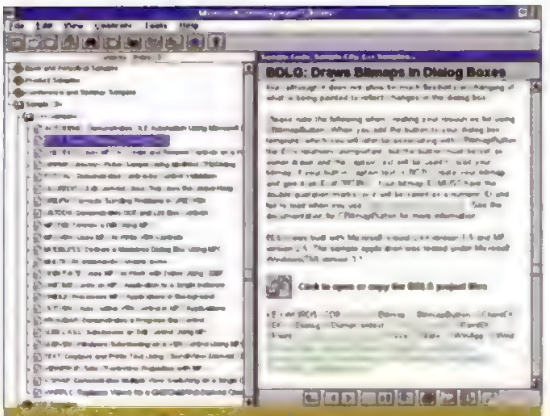
tainment, software, reference, and education (in that order), according to the market-research firm InfoTech.

- The Classics: A few titles that were not updated recently enough to make it into this roundup are among the best-ever CD-ROMs and are still worth noting. Among the classics are Arthur's Teacher Trouble as well as Just Grandma and Me from Living Books (800-521-6263); The Oxford English Dictionary, from Oxford University Press (800-334-4249); SimCity CD-ROM, from Interplay Productions (714-553-6655); and Broderbund Software's Where in the World Is Carmen Sandiego? (800-521-6263).

Windows 95 and CD-ROM

Count on Microsoft's new operating system to deliver several important changes to the way your multimedia PC works.

- With the new AutoPlay feature, you simply stick your



In the Microsoft Developer's Network CD, search programming topics by drilling down through the online manual.

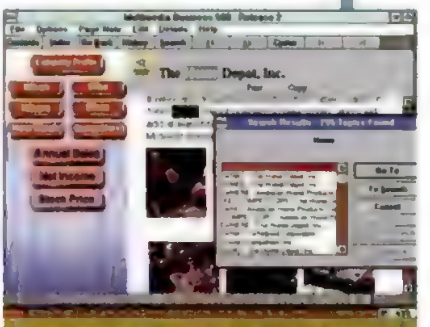
tion, the MSDN makes information from books, magazines, and on-line services available under one compactWindows interface. The new and improved search engine lets you find all information on a topic or drill down to a specific entry.

Microsoft's Windows-based **Microsoft TechNet,** $299 for a single-user license and $699 for an unlimited user license, turns your desktop into a help desk and is the perfect tool for your in-house computer support department. The two-disk monthly subscription set is a collection of the latest tips, information sheets, and drivers for Microsoft products and services. Disk 1 covers questions on subjects that range from Word for Windows to Windows development. Not quite as techie as the Microsoft Developer's Network CD, Microsoft TechNet provides a good reference for common and uncommon questions. The second disk (the Drivers and Patches CD) provides the latest patches or updates to Microsoft products, such as the Excel 5 Pentium patch or service packs for Windows NT 3.1 and 3.5.

Allegro New Media's **Multimedia Business 500, Release 2,** $49.95, compiles information on 500 leading U.S. companies and puts it all at your fingertips. Company information includes an overview, phone and fax numbers, and company reports taken from the 1995 edition of *Hoover's Handbook of American Business.* The information is easily searchable on the Windows-based interface, and the CD automates such tasks as copying, printing, and creating a mailing list. What's more, the Multimedia Business 500 comes with a Prodigy membership kit and a button for accessing up-to-the-minute stock quotes and other information from the service.

SoftKey International's Windows-based **MBA Small Business Edition,** $149.95, is a useful collection of hypertext-linked business and popular texts, video, slide shows, and still pictures, all of which should be of interest to the entrepreneur or small-business owner. The CD uses hypertext to good effect. Many of the sections are footnoted, and you need only double-click on the subscript number to bring up the reference. Some words are defined via help boxes, and all the icons have tool tips. The videos run from conventional advice (like defining "bait-and-switch" ploys and how to avoid them) to the entertaining and informative (how Ben and Jerry's got incorporated).

Learning to type in an airport may not seem natural at first. Nonetheless, Individual Software's $49.95 **Multimedia Typing Instructor** works. Starting out in a high-tech airport lobby, you fill out a passport describing your current typing skills (the program uses this information to tailor the lessons to your needs), and look at kiosks for background information on ergonomics and the history of the typewriter. All areas are explained through the hot cursor.



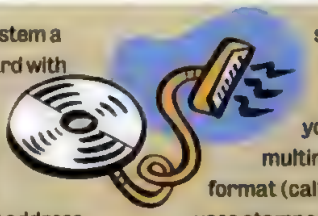
Multimedia Business 500, Release 2 lets you access details on 500 leading U.S. companies.

Once you're past the intro information, you sit in a simulated airplane seat and work on a simulated laptop. You can complete the actual typing exercises and tests in the order suggested by the program or in any order you like. Multimedia Typing Instructor will record your progress, analyzing your speed and accuracy by key, by hand, or by finger.

Combining a snappy search engine with a simple, easy-to-use interface, the **PhoneDisc PowerFinder '95,** $249 from Digital Directory Assistance (DDA), makes finding the business or residential phone listing you need as easy as Touch-tone service. Based on

CD in the drive and the CD loads automatically. Developers must add AutoPlay support to CDs for the feature to work.

- Plug and Play will make your PC multimedia upgrades painless. Add an external CD-ROM to your notebook or give your home system a new sound card with none of the hassles you know so well (like figuring out which IRQ address conflict is tripping you up).
- A new audio CD format supported by Windows 95 will change the way your PC does multimedia. The new format (called CD+), which uses stamped multisession technology from Philips and Sony, will work with both your PC *and* your audio CD player. New titles supporting this format and running under Windows 95 will be able to take advantage of the new OS's 32-bit multimedia subsystem and support such features as AutoPlay. Look for CDs (even traditional audio



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The new Compaq® ProLinea® Family now combines real affordability with innovative new features that make it the most powerful desktop in its class. To start, you can choose the processor you want—from extremely fast (486DX2/50MHz) to blindingly fast (Pentium™ 100MHz). And the ProLinea is available in three new form factors: 3 slots/3 bays, 4 slots/4 bays, or 5 slots/5 bays.

We've also added TriFlex PCI Architecture, PCI Local Bus Graphics, and a host of other features you'll find in the chart to the right. And, naturally, we've made the new Compaq ProLinea Plug and Play compliant. In short, the new ProLinea gives you a whole new way to think about business computing. And there's no easier way to get your hands on one than by calling Compaq DirectPlus.®

The New
Compaq ProLinea Family

Choose Your Compaq ProLinea

Processor	486DX2/66	Pentium 75MHz	Pentium 75MHz
Processor Upgradable	Yes	Yes	Yes
Std./Max. Memory	8MB/136MB	8MB/192MB	16MB/192MB
Hard Drive	420MB	420MB	720MB
Cache Internal	8KB	16KB	16KB
Cache External	256KB (optional)	256KB	256KB
Local Bus Graphics	PCI	PCI	PCI
Video Memory/Max.	1MB/2MB	1MB/2MB	2MB/4MB
Compaq SVGA Color Monitor	Yes	Yes	Yes
Diskette Drive	3.5" 1.44MB	3.5" 1.44MB	3.5" 1.44MB
Expansion Slots (Total)	3	4	5
Drive Bays (Total)	3	4	5
Ports: Serial/Parallel	1/1 (ECP)	1/1 (ECP)	1/1 (ECP)
Security Features	Yes	Yes	Yes
101-Key Keyboard, Mouse	Yes	Yes	Yes
Software Preinstalled	MS-DOS® 6, MS-Windows® 3.1	MS-DOS 6, MS-Windows 3.1	MS-DOS 6, MS-Windows 3.1
Energy Star Compliant	Yes	Yes	Yes
Warranty†	3-Year	3-Year	3-Year

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- Integrated Compaq EasyPoint™ Trackball
- Enhanced NiMH Battery with 2½ to 4 hours of battery life
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- Compaq 192 PCMCIA Fax Modem
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- Optional Docking Base
- Weighs only 5.9 lbs.
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- 3.5" 1.44MB Diskette Drive
- Built-in Enhanced EasyPoint Trackball
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- 6.93 lbs. total carrying weight
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- Compaq 151FS Color Monitor
- Enhanced Keyboard and Microsoft Mouse
- APC Professional 7 Surge Protector

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digitally scanned white pages from 1994 (updated quarterly), and yellow pages listings from Database America, PowerFinder packs 90 million listings—9.5 million business and 80.5 million residential—on five CDs. Each one covers a particular section of the U.S. The numbers in the residential section are scanned in from the phone book; the numbers in the business section are taken from Database America. Searches can be performed by name, street, city, state, ZIP code, or phone number. You can also export, print, or dial any of the listings you find.

CD-ROM technology has proven both a boon and a bust for designers looking for high-quality, royalty-free material to use in their artwork and design. Fortunately, some publishers have taken the high road and avoided dumping loads of public-domain images onto their CDs. PhotoDisc is one such publisher. Its **PhotoDisc Signature Series,** $299 per CD, contains hundreds of excellent photos arranged by theme for the Mac or PC, allowing designers, marketing professionals, and desktop publishers to find the images they need by using a keyword search. Each CD features the work of one photographer under such titles as Colors, Urban Perspectives, The Painted Table, and Children of the World.

Like DDA's PhoneDisc, Pro CD's **Select Phone,** $299, collects its residential listings from white pages published around the country the previous year (the CD is updated quarterly). The difference is that Pro CD, unlike DDA, doesn't scan in the pages. Instead it employs an overseas team of university students to key in the entries. It also uses the white pages to cull its business listings. Standard Industrial Codes (SICs) are added later. No more or less accurate than PhoneDisc, Select Phone, which uses Win32s, fits a total of 84 million listings (72 million residential, 12 million business) on five CDs. The same disks can be used in DOS or Windows or on a Mac. The interface is somewhat more modal that PhoneDisc's but equally effective.

Once you've installed Select Phone, you can pop in disks from any one of the company's other titles, including Free Phone (800 numbers), Canada Phone, and Home Phone, without reinstalling the product. The last CD squeezes 72 million residential listings for the entire country on just two CDs.

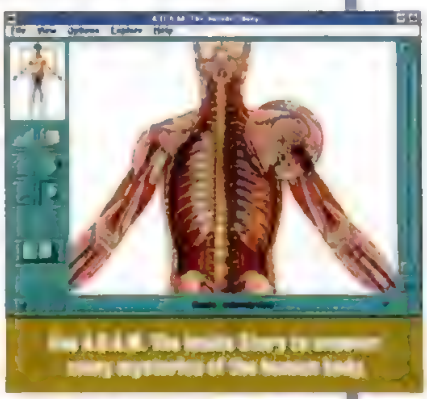
For the

REFERENCE SHELF

Push aside your massive, hard-cover dictionaries and thesauri. These CD-ROMs take up less shelf space and hold as much information as an entire shelf of encyclopedias.

Lots of CD-ROM publishers have tried to illustrate the layers of the human body, but A.D.A.M. Software's **A.D.A.M. The Inside Story,** $39.95, which comes from a company famous for its fine medical drawings, does it best. Installation of this Windows-based program is a breeze.

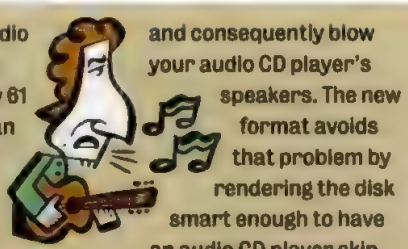
Your tour guides are Adam and Eve, who lead you through some humorous introductory material and their Family Scrapbook, which is full of narration, video, and animation explaining body processes in an entertaining and accessible way. The highlight of this CD is The Anatomy Window, which lets you explore the male or female body unaided. You begin with a front or a back view, then use a scroll bar to peel off skin and organs, layer by layer.



Become a master of the English language with the new **American Heritage Talking Dictionary,** $59.95, from SoftKey International. Based on *The American Heritage Dictionary of the English Language,* Third Edition, the Windows-based CD also includes the *En-*

QUICK SPINS

CDs) that combine music videos and liner notes and perhaps even provide online access to exchanges with (or about) musicians. The new format also helps avoid a common problem found in current CD-ROMs that you might want to run on your audio CD player (Bob Dylan: Highway 61 Interactive is an example). The first track of any CD-ROM contains data that can produce static and consequently blow your audio CD player's speakers. The new format avoids that problem by rendering the disk smart enough to have an audio CD player skip the data file.



CD-ROM Trends

- In 1994, the installed base of CD-ROMs grew 137 percent to more than 25 million worldwide, according to the market-research firm InfoTech. In fact, more CD-equipped PCs than multimedia

Only "MULTIMEDIA-READY" disc drives give you the capacity AND performance you need.

(And only Seagate has a full selection of them.)

Multimedia applications demand higher capacity disc drives. You know that. But were you aware that very few drives actually give you the performance you need?

Seagate now offers "Multimedia-ready" disc drives. Our multimedia-ready drives deliver an average sustained data transfer rate of 3 MB/second or better. So your computers can run full-screen, full-motion video without dropping frames.

The Decathlon 850 and Medalist 1080 deliver the performance required for near broadcast quality video on desktop PCs.

Both drives feature the Fast ATA-2 interface, which is 100% compatible with old IDE, yet up to 400% faster. So you can get the best in both value and performance.

For higher-end SCSI systems, Seagate's Hawk family offers 1 and 2 GB drives. Hawk drives feature Seagate's ASA II architecture to reduce processing overhead and provide superior multimedia performance.

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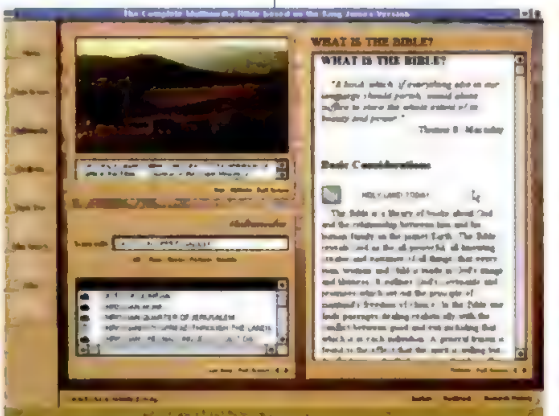
CIRCLE 271 ON READER SERVICE CARD

hanced Roget's U.S. Electronic Thesaurus by InfoSoft International and *The Dictionary of Cultural Literacy* by Houghton Mifflin Company. You can add the CD to a menu of your favorite Windows word processor for easy access. The standard installation copies all files except the voice database (18MB) to your hard disk for quicker searches. The interface is easy to use and offers a split view for both dictionary and thesaurus (which now includes antonyms). Simply click on the Pronounce button to hear the correct pronunciation of most words. WordHunter is an invaluable feature that searches definitions for a specified word and supports Boolean searches, partial words, and capitalization.

The Voyager Co.'s **Beethoven and Beyond**, $24.95, offers plenty of Beethoven—and more. As part of the So I've Heard series, it's aimed at the serious listener and provides a broad introduction to 19th-century Western classical music backed up by numerous examples drawn from a variety of excellent performances. The simple interface, which includes a command history and bookmarks, allows for easy navigation.

The central organizing metaphor is a richly illustrated hypertext essay covering Beethoven's life and the historical background to his works. Taking Beethoven as the foundation, it goes on to survey most of the major musical figures of the 19th century including Schubert, Schumann, von Weber, Chopin, Rossini, Mendelssohn, and Brahms. Embedded in this essay are numerous musical examples. A button click starts the selection, and a changing text prompt draws your attention to musical events described in the essay as they actually occur. The CD is a Windows/Macintosh hybrid.

Sierra On-Line's **Berlitz Live! Spanish,** estimated street price $110, takes advantage of the tried-and-true Berlitz method for teaching survival Spanish for travelers. Most pronounciations and grammar follow Latin American Spanish conventions. With an Incan princess leading you along, you begin by watching an introductory cartoon, then navigate through a series of lessons. Each lesson, in turn, is introduced by a dialog cartoon in which you listen to Spanish speakers. As in all parts of the program, you can opt to read what's going on in Spanish and/or in an English translation. A guide offers cultural insights; if you have a microphone, you can record your pronunciation and compare it to that of a native speaker. The CD includes a Spanish-English/English-Spanish dictionary and works on both Windows and Macintosh systems.



The Complete Multimedia Bible is a fun tour of the Biblical world via sights, sound, and text.

Creative Multimedia's **Beyond the Sambatyon: The Myth of the Ten Lost Tribes**, estimated street price $30, was created in conjunction with The Museum of the Jewish Diaspora in Tel Aviv. It tells the story of the ten lost tribes of northern Israel, conquered by the Assyrians in 722 B.C. and exiled to modern-day Iraq and Syria. The origins of Jewish communities across every continent are examined. Its documentary style and good use of photographs, engravings, letters, travelogues, and interviews from the original exhibit make this a worthwhile addition to any library. The CD works on both Windows and Macintosh systems.

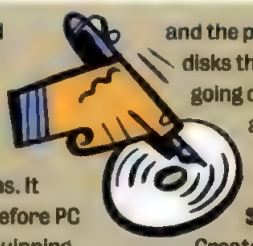
The Complete Multimedia Bible, $49.95 from Compton's NewMedia, is a Windows-based CD with a rich mix of sound, video, and text. The title, a version of the King James Bible, includes the Old and New Testaments. It's easy to install and run and has a slick interface that guides you through the program. You can do word and topic searches and see photographs and short movies about Biblical times—and even listen to parts of the Bible read by James Earl Jones.

Compton's Multimedia Encyclopedia, which came out in 1990, was the first of its kind. Now Compton's NewMedia offers the latest version (3.0) of this work: **Compton's Interactive Encyclopedia,**

QUICK SPINS

upgrade kits were sold.

- Watch for an upswing in the compact disk-recordable (CD-R) market. CD-R drives are not as prohibitively expensive as they used to be (they're about $1,000 now, down from thousands more a few years ago), and prices are expected to plummet further in the next few months. It won't be long before PC vendors are equipping systems with CD-R drives, and the price of CD-R disks themselves are going down. You'll find a useful mastering package in Corel Corp.'s $249 Corel CD Creator, which lets you store data, music, and mixed-media files. CD Creator includes data and audio editors as well as a status bar showing free disk space.



- Before long, CD-ROMs will become an impulse buy—vendors will price titles at less than $15—and

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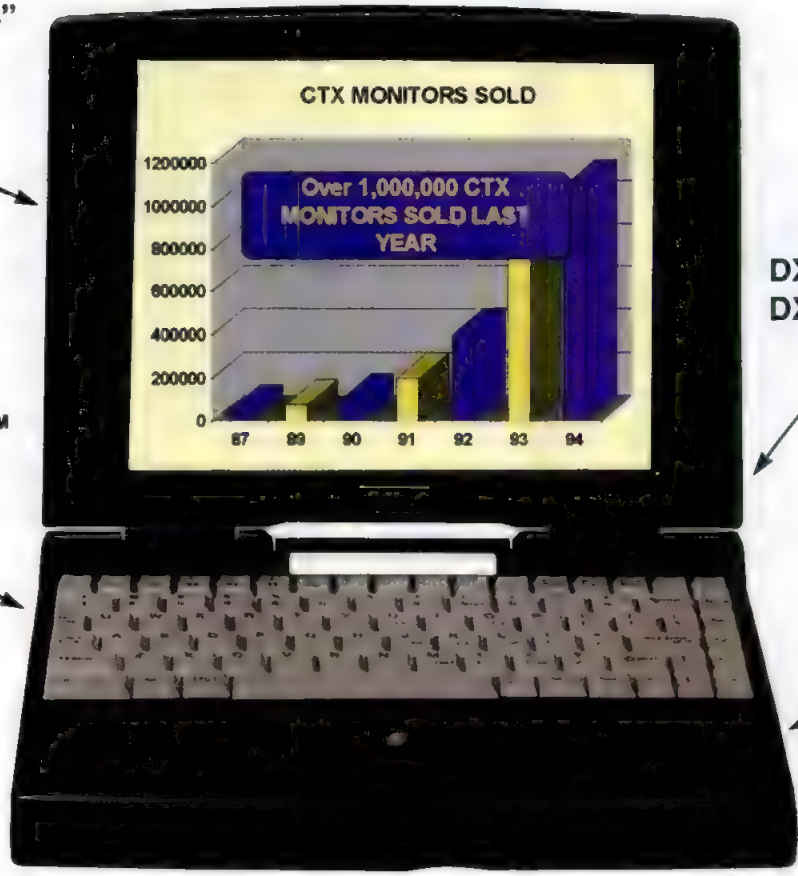

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CIRCLE 329 ON READER SERVICE CARD

1995 Edition, estimated street price $70 to $90. More than just an upgrade, this CD-ROM has a whole new face. Unlike Grolier's or Encarta, Compton's interface is not a tall model. No matter what area you're perusing, the interface remains the same. Among the highlights are several new ways to access the always rich content, making it not just a good source of information but one that's fun to explore.

One of the new features in this version is a video tour narrated by actor Patrick Stewart, who explains how to use the Windows-based encyclopedia. Also new are the four learning environments: a newsroom, a playroom, a spaceship, and an attic. Another new feature is the Editing Room.

This new edition contains the complete text of all 35,000 articles in the print edition of Compton's Encyclopedia, as well as maps, charts, more than 14 hours of audio, more than 7,000 still images, and 80 videos and 3-D animations.

At $1,500, Oxford University Press's gorgeous **Frank Lloyd Wright: Presentation and Conceptual Drawings** is not for everyone. The package, which includes four CDs and two floppy disks (for the search engine software) is highly resource-intensive: You need 8MB RAM and a 10MB swap file at the minimum for this Windows CD, and the company recommends 16MB of RAM, a 48MB swap file, and use of a 1,024-by-768 true-color display.

Still, for anyone interested in researching the master's drawing collection, the package is invaluable. The CD, developed by Luna Imaging, includes all the presentation and conceptual drawings in the Frank Lloyd Wright Archives (other drawings exist in clients' collections). Many of these are previously unpublished, and this is the largest single body of these works. Each drawing is thoroughly indexed by draftsman, date, location, description, where it has been displayed, and so on. The images are beautiful.

You can zoom in and out and control contrast, size, and brightness for printed output. Oxford also includes a user guide and an introduction book that reads like a museum catalog. Probably not a CD-ROM for the masses, but for libraries and architecture firms, it's sure to be love at first site.

Cambrix Publishing's **Her Heritage, A Biographical Encyclopedia of Famous American Women,** estimated street price $29, is exactly what this Windows/Macintosh CD-ROM claims to be: a biographical encyclopedia of famous women. It contains more than 1,000 biographies, and the mere fact that a CD such as this exists is heartening. You get short film clips of some of the women; the write-ups are comprehensive and compact, and the hypertext links can be enlightening.

Stan Grist has spent his life of traveling the globe and looking for hidden treasures, large and small. With Follgard CD Visions' **Lost Treasures of the World with Stan Grist,** street price $50, he provides you with some of the knowledge and tools of his trade and also shares some of his more colorful experiences. There are a lot of talking-head, small-window videos and some slide-show material. One of the most interesting features of the CD is 5,000 Treasures, which lets you can search a database of 5,000 alleged treasure sites and find the perfect spot to begin your own search. Grist also provides business, legal, and tax information related to treasure hunting. The interface of this Windows- and Macin-

QUICK SPINS

the titles will proliferate in the mass marketplace, with distributors selling into the Kmart channel. ESX Interactive Media, a division of the music CD retailer Essex Entertainment, is spearheading the mass-market effort by shipping 50 CD-ROM titles with retail prices of $9.95 to music stores, bookstores, and budget retail outlets nationwide. ESX will release 50 more titles later this year at retail prices of $14.95 and below.

● Movies on file: Anticipating increased demand for MPEG-1 and MPEG-2 full-length movies, manufacturers are working to solidify specifications for high-density CD-ROM drives and disks. According to InfoTech, two alliances are battling to push different high-density standards into the mainstream. Sony and Philips—licensers of CD-Audio, CD-ROM, and

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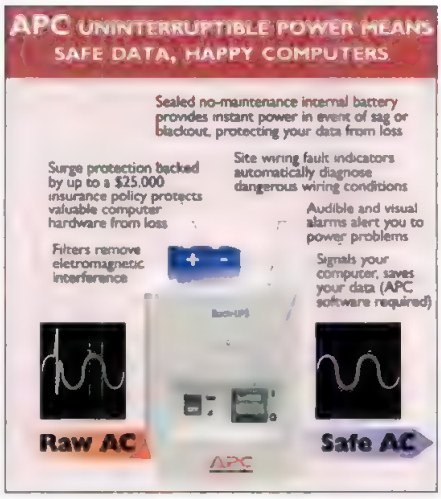

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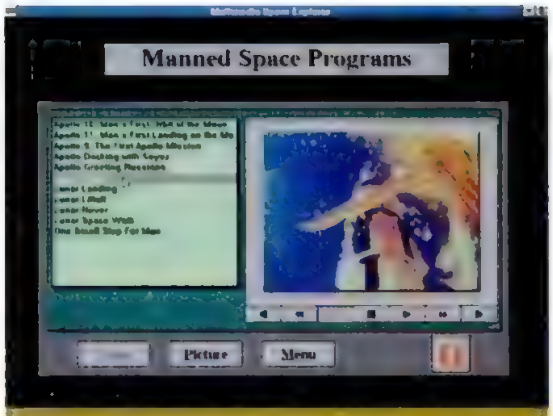
tosh-compatible CD is attractive and simple.

Microsoft Encarta '95, Microsoft Corp.'s new version of its outstanding Windows-based multimedia encyclopedia, estimated street price $100, has a slick, easily navigable interface and excellent content. You select your area of interest—Physical Science and Technology; Life Science; Geography; History; Social Science; Religion and Philosophy; Art, Language, and Literature; Performing Arts; Sports, Hobbies, and Pets—and select a subcategory. The Pinpointer (a search tool) calls up all related articles. Click on the name to call up the article or further narrow the search by selecting one of the Pinpointer icons (Word, Category, Media, Time, and Place).



A plethora of video files from the NASA film archives makes

The Media gallery includes the usual suspects—images, sound, video—and InterActivities, which guide you through some stimulating topics. InterActivities include Ellis Island, Exploring Fractals, Orbit, Personal Nutrition, World Languages, and World Music. Encarta includes an atlas—which you can click on for information, related articles, and media clips—as well as a dictionary and thesaurus. You can create bookmarks and jump to Windows Write for notetaking.

Grolier Electronic Publishing's Windows-based **1995 Grolier Multimedia Encyclopedia**, estimated street price $89, is an exceptional all-purpose reference work. Grolier's interfacedoesn't match Encarta's sublime usability. The main features screen, which centers on a stack of black boxes, leads to different parts of the CD, and you can access Timelines, Multimedia Maps, Word Search, and multimedia clips, to name but a few of the sections provided. In the Knowledge Explorer, you drill down to entries in such areas as Art, History, or Science and Technology. The sophisticated time lines include information on not just historical events but also on civilizations, social trends, and movements. The Pathmakers feature, new in this edition, features six areas—such as The Artist in the Modern Era and Explorers and the Horizons of Discovery—with related articles and previews from a personality related to that topic. The topics are far-reaching, as they should be in an encyclopedia, and the videos and audio tracks used to further elucidate different topics are well chosen and of good quality.

With Betacorp's Windows-based **Multimedia Space Explorer**, $39.95, the history of the United States space program—from John F. Kennedy's famous space address to the Hubble telescope—has been indexed on a single CD-ROM. You can choose from eight different exploratory windows: Space Timeline, Multimedia Library, Unmanned Missions, Technology & Science, Shuttle Research, Manned Missions, Future Explorations, and Exploring the Solar System. Space Timeline, Unmanned Missions, and Manned Missions cover each of NASA's past space explorations, complete with descriptions, still-frame photographs, and an occasional nostalgic film clip. In-depth descriptions of space research can be found under Technology & Science and Shuttle Research, while Future Explorations tells of upcoming space station efforts.

Brøderbund Software's **PC Globe Maps 'N' Facts**, estimated street price $35, improves upon already explored territory. This latest version of perhaps the first worthwhile atlas on CD-ROM (Windows/Mac-based) adds new up-to-date maps, charts, and data to an already strong set of geography tools. While its visual presentation may not be as flashy or innovative as that of 3D Atlas, it is easy to use.

New here is the ability to compile custom lists of countries and compare them in over 200 categories; recent statistics on the environment and on children have been added. This wealth of statistical data, coupled with a fine selection of highly readable maps, makes PC Globe Maps 'N' Facts the perfect homework companion for kids aged 12 and up.

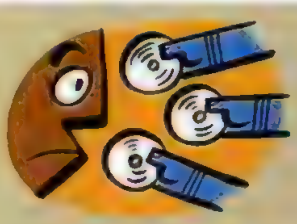
QUICK SPINS

Video CD standards—have developed a high-density specification, and Time Warner, Toshiba, and a host of other vendors have developed a different specification together. You will definitely be seeing full-length movies on CD in the future, but whose technology will become the standard remains to be seen.

CD-ROM Facts

The following section was compiled from information provided by Dataquest, a market-research firm.

- A large number of new CD-ROM developers and publishers appeared on the scene during 1993 and 1994. Right now there are approximately 8,000 to 10,000 CD-ROM developers and 200 to 300 CD-ROM publishers. While developers are in charge of

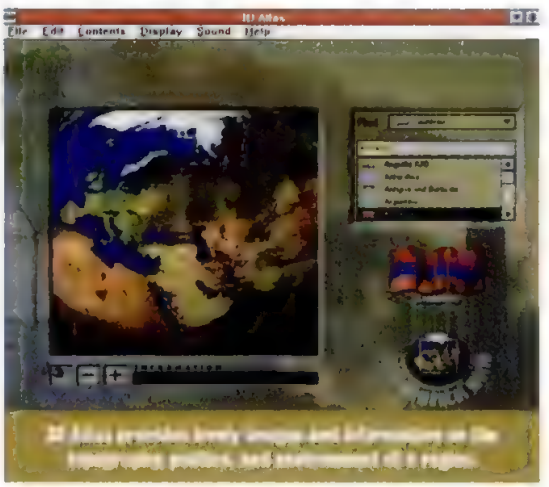


content, publishers take care of marketing and arrange for

Bayware's **Power Japanese 2.0**, estimated street price $165 to $199, is a great example of how to use multimedia features in a learning product. Four sections—native (Hiragana) syllables, basic grammar, advanced grammar and dialogues, and foreign (Katakana) symbols—are presented in lessons that incorporate the right mix of animation and sound. The lessons in this Windows-based CD are well organized, with reading, writing, and pronunciation coaching in each session. A voice record/compare program, a rudimentary word processor that supports both Hiragana and Katakana symbols, and a collection of prerecorded common phrases are included.

The Random House Unabridged Electronic Dictionary, $79, is an updated version of Random House's dictionary on CD-ROM. The product now has added multimedia features: You can hear pronunciations of most words and see illustrations of some words. Searching capabilities are strong and include Boolean operators and wildcards. Etymologies are included, and you can click on any word in a definition to move to the entry for that word. Browse on any word and move to adjacent entries with a click or two.

Fairfield Language Technologies' **The Rosetta Stone Level Ia Russian**, $395, operates on the notion that there's no need to wait until you've learned vocabulary or even the Cyrillic alphabet before you start using Russian. This instructional CD-ROM yanks you into the process by presenting four pictures and a phrase (or, alternately, one picture and four sounds, or one picture and four phrases or words). You choose the picture that matches the phrase—even though you haven't a clue. But the funny thing is that with this method, you catch on more quickly than if you had begun with, say, aimless vocabulary drills.



The Rosetta Stone varies its technique by giving a phrase with voice and text, voice only, or text only; the idea is that listening comprehension is the primary skill, and everything else follows. The screen is logically ordered, with buttons for referring to information, toggling between modes, and repeating a phrase. Using your keyboard, you can also practice dictation. The Rosetta Stone also lets you record your voice and compare your pronunciation with that of a native speaker.

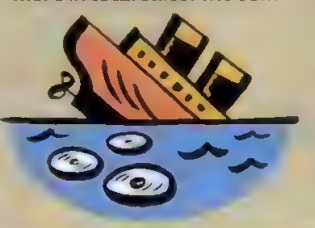
With **The Rosetta Stone PowerPAC**, $99, also from Fairfield Language Technologies, you can learn English, French, German, Russian, and Spanish at your own pace. The simple interface, which is composed of photos and text as in the company's other language packages, emphasizes vocabulary, pronunciation, and sentence structure. It's helpful in letting you choose, for example, whether you'd like to try to match a word or phrase to a picture by looking at the text, hearing it, or both. This is a terrific price for learning five languages. In the Rosetta Stone's single-language CDs, you get 92 chapters; in the PowerPAC you get the first 22 chapters of each separate language title. The company's CDs can run on Windows and Macintosh systems.

With The Rosetta Stone, you use Russian before you even learn Cyrillic.

While ABC/EA's **3D Atlas**, $79.95, claims to be just an atlas, this Windows-based CD-ROM offers a lot more than just maps. At the heart of the program lies a beautifully rendered 3-D globe that can display anything from environmental regions to political boundaries to topographical maps. To choose a country, you just click on the globe and watch it spin to your desired location. You can also select from the contents, where you can click from a menu or type in the country you want. Once you get to the country of your choice, you can read a country profile, learn about the population distribution and main exports, and view scenic photos.

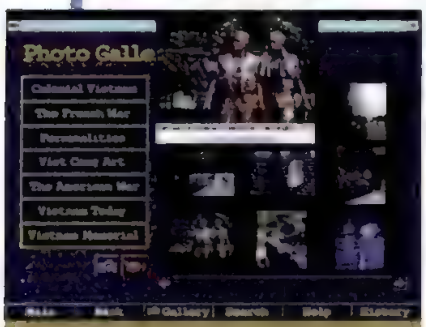
production. In most cases, publishers contract out to a manufacturer for the actual CD-ROM production.

- The current top ten CD-ROM publishers have earned around $50 million to $100 million in total sales.
- The CD-ROM market is in constant flux, and predictions are that there will be a huge drop in the number of developers and publishers in the near future. Industry sources say there will be about 20 to 30 publishers who will ultimately make it. These are the companies who are earning $10 million or more in total sales. The companies who don't make it will go under, be bought by the successful publishers, or find a place in niche markets.



- Experts estimate that most of the top 15 to 20 publishers employ around 20 to 30 people. Microsoft, obviously, is an exception to the rule.

But what sets this program apart is the inclusion of 3-D flights that let you tour some of the geographic wonders of the world; time-lapse photos that let you see events take place over time; videos on biomes such as savannah, rainforest, and desert; and a section that lets you sort and compare economic, population, environmental, and agricultural statistics on countries of the world.



Poignant images of the war and its aftermath inspired Medio Multimedia's Vietnam CD-ROM.

Mindscape's **20th Century Video Almanac**, **$49.95**, lets you experience every major world history event and trend from 1890 through 1994. See and learn about such history-making events as President Kennedy taking the oath of office, Queen Elizabeth's coronation, man's first step on the moon, and World War II attacks, or check out trends such as styles from the twenties. You get a disk full of video clips, images, and text pieces, every word of which can be treated as hypertext. The Windows interface is attractive; the windows have metallic gold borders, and every icon is cunningly animated.

Medio Multimedia's Windows-based **Vietnam**, $59.95, provides an amazingly thorough study of the war and of the places and people involved with and affected by it. The events leading up to the war and the repercussions of the war are discussed, and you get insight into the points of view of the Vietnamese and the Americans—civilians, officials, soldiers, nurses. The nationalist fervor that grew under Ho Chi Minh is studied and explained. A time line starts off with French Indochina and gives a background of Vietnamese history and imperialist advances into Indochina; the chronology goes right through the war.

An overview explains why the U.S. went to war, what sparked the antiwar protests, and why the U.S. finally pulled out. The text of George Herring's *America's Longest War* is included, as are excerpts from other books. The video clips and eerie soundtrack recapture the feelings of the time with an accuracy that will astound you.

For the HOME

Unlike an office, where all your tools are usually within arm's reach, the home has different places of activity: the kitchen, the workroom, the living room, the yard—each with its own particular set of tools and equipment. The following CD-ROMs offer a little something for every room and should fit nicely in any home.

Cambrix Publishing's **The Art of Making Great Pastries**, estimated street price $28, contains 101 recipes for pastries, each with a full-color picture and instructions. Terms, tips, and techniques combined with video clips make learning easy and enjoyable in this Windows-based title. The recipes are divided into categories, and the user-friendly interface makes selection a breeze. For the novice, there are explanations and step-by-step instructions for uncommon things such as crepes with ginger and ganache. You can play soothing music while viewing the recipes and instructions, or you can turn the music off.

Try out the many recipes in 4 Paws of Crab—such as this one for soy-fried rice noodles.

The Art of Making Great Pastries

Live Oak Multimedia's **4 Paws of Crab**, $44.95, specializes in recipes for Thai cooking. The

QUICK SPINS

- The average annual revenue for CD-ROM developers is under $100,000. The average annual revenue for CD-ROM publishers is under $1 million.
- Total 1994 factory revenue for the CD-ROM industry, not including retail sales, is $650 million.
- Dataquest estimates that there were 3,000 new titles in 1993 and 8,000 new titles in 1994.
- Experts anticipate the number of CD-ROM titles in 1995 to be from 3,000 to 5,000.
- 62 percent of CD-ROM titles are developed on the Macintosh; 90 percent of all CD-ROM titles, however, are released first or exclusively for Windows.
- The average time it takes to produce a CD-ROM is about six months.
- The average cost of developing a title depends on its content. A title with only audio and graphics will cost $100,000 to

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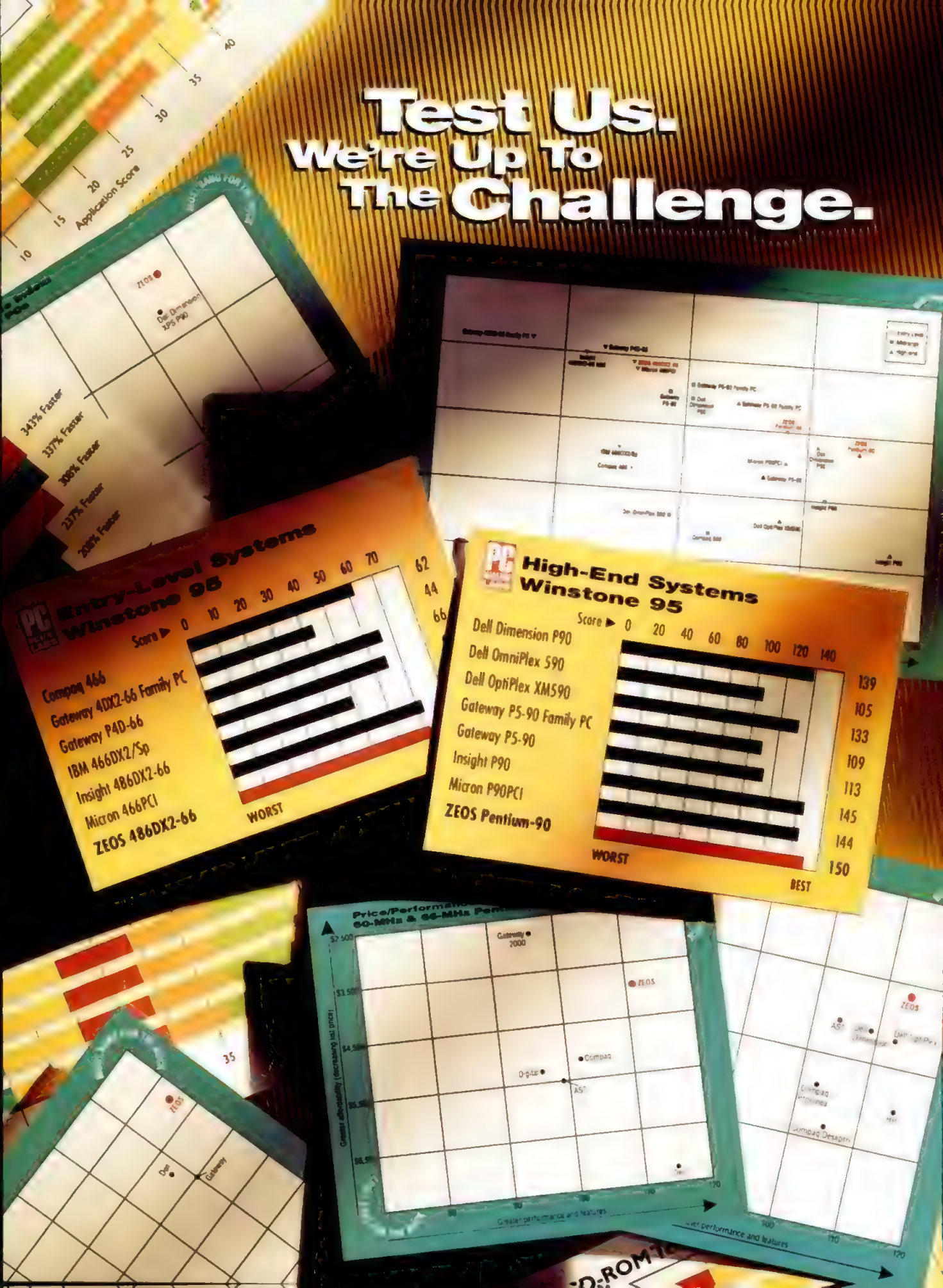
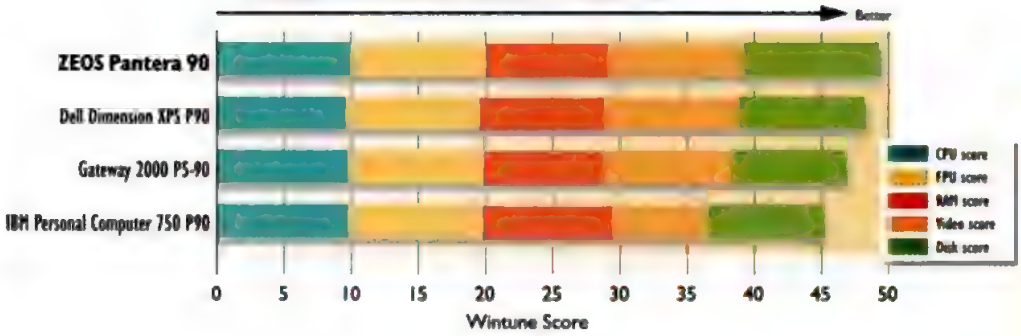


ZEOS
ZEOS

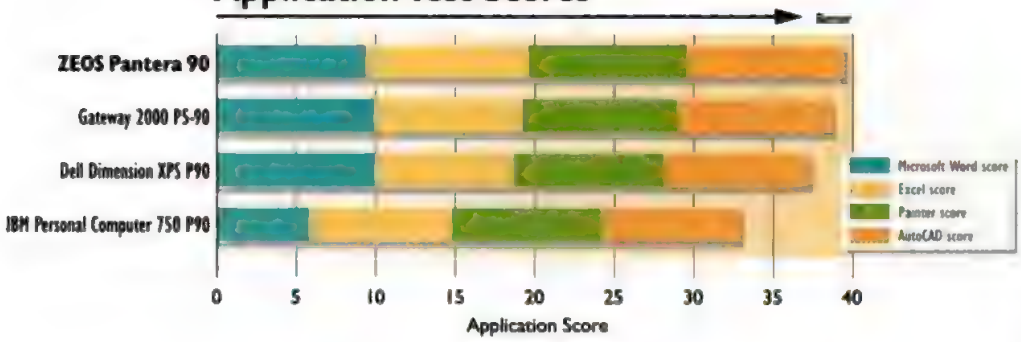
Once Again...
"ZEOS® Clobbers The Competition."

– *Windows Magazine*, April 1995

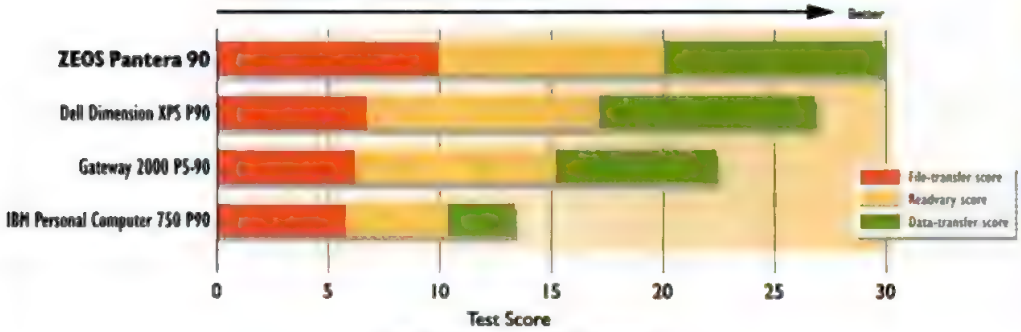
Wintune Benchmark Scores



Application Test Scores



CD-ROM Test Scores



Reprinted from Windows Magazine, April 1995

"In all three of our test batteries the ZEOS Pantera™ computer was clearly faster than any of the others."

–*Windows Magazine*, April 1995

PC MAGAZINE EDITOR'S CHOICE
Pentium-66
April 12, 1994
DX4-100
June 28, 1994

COMPUTER SHOPPER
Pentium-60
April 1994
Pentium-90
August 1994

PC WORLD BEST
486DX2-66
January 1994
February 1994
March 1994
June 1994
December 1994
January 1995
February 1995
March 1995
April 1995
DX4-100
October 1994
November 1994
December 1994
Pentium-60
December 1994
January 1995
February 1995
April 1995
Pentium-66
June 1994
July 1994
August 1994
September 1994
Pentium-90
August 1994
September 1994
October 1994
November 1994
January 1995
February 1995

PCs Best
Pentium-66
May 1994
Pentium-90
February 1995

Windows EXPERTS' PICK
Pentium-66
June 1994
Pentium-90
August 1994

Pentium-90
November 1994

WINDOWS 1995 WIN 100
Pentium-90
May 1995

Package 1		Package 2		Package 3		Package 4	
486DX2-50	$1245	486DX2-50	$1545	486DX2-50	$2045	486DX2-50	$2445
486DX2-66	$1295	486DX2-66 CN!	$1595	486DX2-66 CN!	$2095	486DX2-66	$2495
DX4-100	$1445	DX4-100	$1745	DX4-100 CN!	$2245	DX4-100	$2645
Pentium-60	$1545	Pentium-60 CN!	$1845	Pentium-60	$2345	Pentium-60	$2745
Pentium-75	$1645	Pentium-75 CN!	$1945	Pentium-75 CN!	$2445	Pentium-75	$2845
Pentium-90	$1745	Pentium-90	$2045	Pentium-90 CN!	$2545	Pentium-90	$2945
Pentium-100	$1895	Pentium-100	$2195	Pentium-100	$2695	Pentium-100 CN!	$3095
Pentium-120	$2145	Pentium-120	$2445	Pentium-120	$2945	Pentium-120 CN!	$3345
➤ 4MB RAM ➤ **528MB** local bus IDE hard drive, 14ms ➤ 3.5" 1.44MB floppy disk drive ➤ **Diamond Stealth 64** PCI local bus SVGA color graphics card with 1MB DRAM ➤ ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ Microsoft Mouse ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **MS Works**		➤ 8MB RAM ➤ **850MB** local bus IDE hard drive, 11ms ➤ **4X CD-ROM** drive and 3.5" 1.44MB floppy drive ➤ **Diamond Stealth 64** PCI local bus SVGA color graphics card with 1MB DRAM ➤ ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ Microsoft Mouse ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **MS Works Multimedia CD**		➤ 16MB RAM ➤ **1GB** local bus IDE hard drive, 12ms ➤ **4X CD-ROM** drive and 3.5" 1.44MB floppy drive ➤ **Diamond Stealth 64** PCI local bus SVGA color graphics card with 1MB DRAM ➤ **ZEOS 15"** 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ Microsoft Mouse ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **MS Office Pro & Bookshelf CD**		➤ 24MB RAM ➤ **1.2GB** local bus IDE hard drive, 10ms ➤ **4X CD-ROM** drive and 3.5" 1.44MB floppy drive ➤ **Diamond Stealth 64** PCI local bus SVGA color graphics card with 1MB DRAM ➤ **ZEOS 15"** 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ Microsoft Mouse ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **MS Office Pro & Bookshelf CD**	

Included With Every ZEOS Pantera:

- Genuine Intel® Processor. ZIF socket for easy upgrading.
- Diamond Stealth PCI local bus color graphics card with 1MB DRAM, upgradable to 2MB DRAM.
- Flash BIOS.
- Two high-speed serial ports and one enhanced parallel port on the motherboard.
- Slots: Three PCI & 4 ISA (486), 3 PCI & 5 ISA (Pentium).
- ZEOS 101-key space-saving keyboard.
- 200 watt power supply with built-in surge suppressor. Switchable between 115/230V.
- FCC Certified Class B; UL Listed.
- Complete ZEOS Customer Satisfaction Package.

486 & DX4:

- RAM expandable to 128MB.
- EPA Energy Star compliant.

Pentium™ 60:

- 6 SIMM slots for low-cost upgrading. RAM expandable to 384MB.
- On-board Fast SCSI-2 option.

Pentium™ 75, 90, 100 & 120:

- 6 SIMM slots for low-cost upgrading. RAM expandable to 384MB.
- On-board PCI local bus Fast SCSI-2 and Ethernet LAN options.
- EPA Energy Star compliant (75, 90 & 100).

Favorite Options

1GB to 1.2GB Hard Drive Upgrade $95

528MB to 1GB HDD Upgrade $170

1MB to 2MB Video DRAM Upgrade $59

Diamond Stealth 64 Video PCI Graphics Card with 2MB VRAM
Fastest 64-bit accelerated video $249

Upgrade from a 14" to a 15" Monitor
ZEOS SVGA NI, 1024 x 768, flat screen $95

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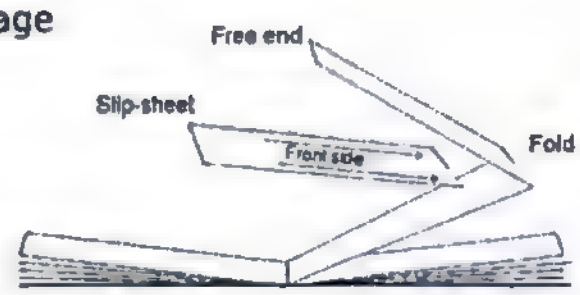
Folded edge of the page

GbsSlipSheet-001

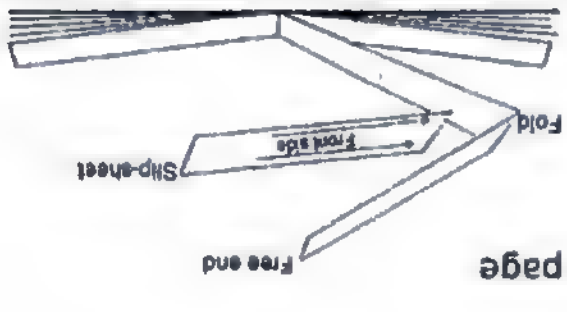
Foldout slip-sheet

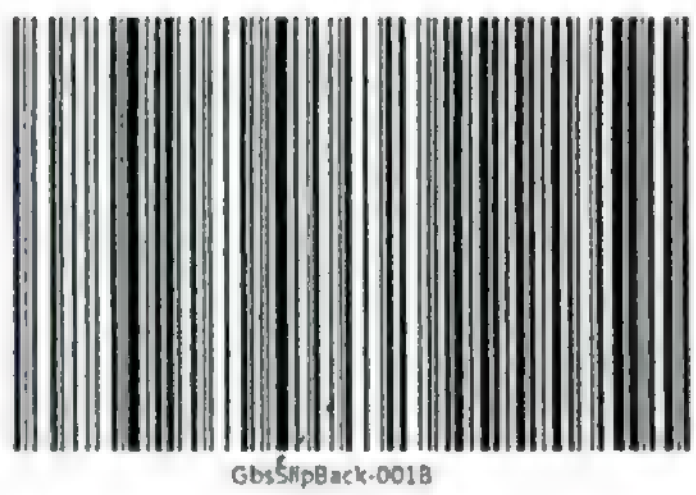
1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





Back

1. Follow instructions on the other side

Inverted Back

1. Follow instructions on the other side

ZEOS® Pantera™ Scores Big.

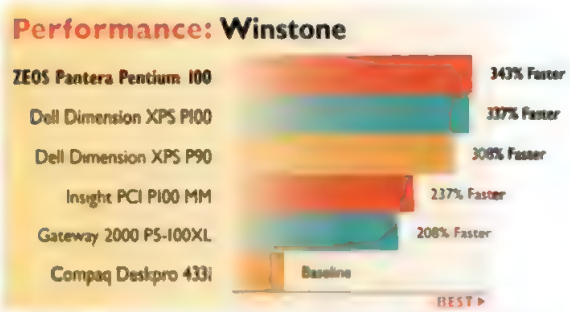
High Power, Low Price Make You The Winner

"With high performance and a low price, this (Pantera) is the kind of high-end system we should all have," exclaimed *PC/Computing* in their April 1995 review of Pentium-100 systems.

Without a doubt, leading experts from top industry publications agree that the ZEOS Pantera is your No. 1 high-performance desktop system.

Just listen to what *Windows Sources* said: "The clear winner is the ZEOS Pantera. Its scores were the best across the board."

Unparalleled in the history of personal computing, the Pantera has continuously earned award after award—review after review—from *PC Magazine, PC World, PC/Computing, Windows Magazine,* and many more. Facing the challenge head on, "ZEOS clobbers the competition."



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Usability: *Big but good.* * * * *
Performance: *Impressive.* * * * *
Technology: *Great sound.* * * * *
Verdict: *A definite winner.* * * * *

Reprinted from PC/Computing, April 1995

Top-Ranked Performance

The Pantera, based on Intel's 486, DX4 and Pentium processors, leaps ahead of the pack with record-breaking performance and awesome power.

In their December 1994 Pentium and 486 roundup, *PC Magazine* gave top honors to the ZEOS Pantera: "Few product lines fared as well in our price/performance index as the ZEOS Pantera family....The Pentium machines produced first-place scores in their respective tiers, and the ZEOS 486DX2-66 earned a top-five ranking among the entry-level systems."

What makes the Pantera the top performer—time after time? Superior engineering—starting with a ZEOS designed motherboard created specifically to take full advantage of the latest technological advancements. The motherboard is loaded with exceptional features such as PCI Local Bus expansion which delivers 32-bit data at a rate up to 132MB per second, an on-board PCI Local Bus Enhanced IDE Controller, and support for up to four IDE devices. EIDE hard drives are available to 1.2GB standard, upgradable to 4GB SCSI. For optimum EIDE hard drive performance, the Pantera even supports Programmed I/O Mode 4, which gives you the fastest data transfer rates possible.

For top performance, you also get a Diamond Stealth 64-bit PCI video card *standard* for the fastest video performance, and a 4X CD-ROM for increased data transfer rates.

Buy With Confidence

ZEOS is committed to providing you with an excellent value. With all the extras, options and compatibility with all major operating systems—including Novell NetWare—you can't go wrong with the award-winning Pantera.

And with our *Computers Now!* program, many of our most popular money-saving Pantera packages are ready to ship *the same day you order*—look for the CN! logo. We also give you the option to custom-design a system to your computing needs.

Either way, you can buy with confidence because of our on-going dedication to provide you with high-quality features and state-of-the-art technology at an exceptional price.

There's more. ZEOS gives you unbeatable service and support on a completely reliable system. *PC Magazine* agrees: ZEOS has won seven *PC Magazine* Readers' Choice for Service & Reliability awards. And ZEOS was the first to provide you with 24-hour toll-free technical support—every day.

With striking performance, unequaled reliability and definitive value, the ZEOS Pantera is charting a new course in personal computing. It will make you the winner. To get the *Fastest Cat* around, call your ZEOS Systems Consultant today at 800-554-7172.

ZEOS® Can Ship Today!

486DX2-66 $1595
Pentium-60 $1845
Pentium-75 $1945

Package #2:
- 8MB RAM
- 850MB local bus IDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB FDD
- Diamond Stealth 64-bit PCI local bus SVGA graphics card with 1MB DRAM
- 14" SVGA color monitor
- 6-bay desktop case
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- MS Works Multimedia CD

Pentium-75 $2295

Top Gun:
The above system modified to include:
- 256K SRAM cache
- Diamond Stealth 64 Video PCI local bus graphics card with 2MB VRAM
- 15" SVGA color monitor upgrade
- 14.4/14.4 send/receive fax modem

Pentium-75 $2545
Pentium-90 $2745
Pentium-100 $2895
Pentium-120 $3145

Hottest:
- 16MB RAM, 256K SRAM cache
- 1GB local bus IDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB FDD
- Diamond Stealth 64 Video PCI local bus graphics card with 2MB VRAM
- 15" SVGA color monitor
- 6-bay desktop case (Pentium-75) 10-bay vertical case (Pentium 90, 100 & 120)
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- MS Office Pro & Bookshelf CD

Pentium-75 $2995
Pentium-90 $3095

Best MM:
- 16MB RAM, 256K SRAM cache
- 850MB local bus IDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB FDD
- 16-bit sound card, stereo speakers
- Diamond Stealth 64 Video PCI local bus graphics card with 2MB VRAM
- 17" SVGA color monitor
- 10-bay vertical case
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- MS Office Pro & Bookshelf CD

Pentium-90 $3645
Pentium-100 $3795
Pentium-120 $4045

Best MM Supreme:
The above system modified to include:
- 24MB RAM
- 1.2GB local bus IDE hard drive
- High-power speakers w/ subwoofer

486DX2-66 $1345

Package #2:
- 8MB RAM, 128K SRAM cache
- 528MB hard drive
- 3.5" 1.44MB floppy drive
- VESA local bus SVGA color video
- 14" SVGA color monitor
- 4-bay desktop case
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- MS Works

DX4-100 $2995

Package #3:
- 8MB RAM
- 350MB IDE hard drive
- External 3.5" 1.44MB floppy drive
- 14.4 PCMCIA fax/modem
- 7.9" dual-scan color VGA display
- Custom leather carrying case
- Extra battery
- MS-DOS, Windows for Workgroups
- MS Works
- 7.8" x 10.2" x 1.7"; 4.1 lbs

For active matrix display, add $700.

Pentium-75 $3795

Package #2:
- 16MB RAM, 256K SRAM cache
- 528MB IDE hard drive
- Internal 3.5" 1.44MB floppy drive
- Integrated stereo sound
- 10.3" dual-scan color SVGA display
- Custom nylon carrying case
- Extra battery
- MS-DOS, Windows for Workgroups
- MS Office Pro
- 8.9" x 11.7" x 2.1"; 6.8 lbs.

For active matrix display, add $800.

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1. Choose the ZEOS system package you want. (A sampling of our *Computers Now!*®—CN!—packages is shown at left.)
2. For same-day shipping, call ZEOS at 800-554-7172 before 1 p.m. Central Time, Monday-Friday.
3. Upon credit approval, we'll ship your system *the same day you order!*

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If we accept your order for immediate shipment and fail to ship your system under the conditions outlined, we will ship it *at our expense* as soon as it is ready.*

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PKS PCM 94060

CIRCLE 155 ON READER SERVICE CARD

Villa Crespo Software's Kittens to Cats has tips on caring for your feline pet, and covers exercising and grooming.

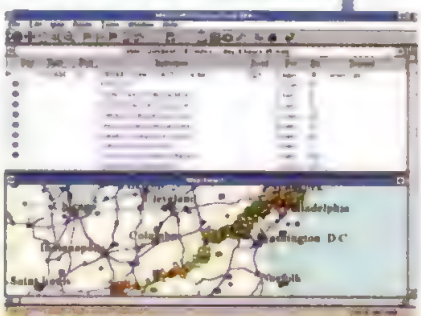
recipes are divided into Noodles and Rice, Appetizers, Desserts/ Drinks, Curries, Stir Fries, Salads, and Soups. They include such tempting treats as Chicken Soup with Rice, Thai Tofu Soup with Greens, and Stir-Fried Mushrooms in Oyster Sauce. The recipes are accompanied by demonstrations, and you can click on some of the ingredients for helpful explanations. Details on the culture of Thailand accompany the recipes. This Windows-based CD has interesting, fresh ideas, and the outstanding collection of recipes is a must for any cook.

Home PC Library, $59.95, and **PC Library**, $99.95, from Allegro New Media, provide a wealth of information to computer users interested in learning more about hardware and software. The Windows-based CDs include such helpful texts as The Complete Idiot's Guides along with Que's Computer User's Dictionary and many other titles. The Home PC Library covers such topics as entertainment, hardware, home offices, on-line services, OS software, and reference. In the PC Library, you'll find answers to questions about communications, database management, graphics software, home-office management, PCs, spreadsheets, and word-processing software. The packages have video demonstrations of how to use software packages and hardware components. Hypertext tools make searching through these collections a breeze.

Kittens to Cats, from Villa Crespo Software, $49.95, is the perfect owners' manual if you have a cat or are planning to adopt one. This Windows-based CD-ROM is loaded with information ranging from picking the best kitten to dealing with grief when your cat moves on to that big litter box in the sky. Along the way, you get tips on training, behavior, health, and nutrition. Kittens to Cats uses video clips and crisp graphics throughout, which is useful when demonstrating correct methods of grooming, first aid, and administering medication. Easy installation, the ability to run directly from the CD-ROM drive, and a push-button interface make this package a must for cat lovers of all ages.

Future Vision Multimedia's **Martial Arts Explorer**, $49.95, combines an intuitive and attractive interface with some top-notch content. This Windows/Macintosh hybrid title begins with a long video explaining its premise: Tansakusha is an Eastern explorer who is fascinated with the history, philosophy, and practice of the martial arts. He has made it his life's work to assemble a collection of information on the subject. Your task is to explore his collection—which includes a handwritten diary (complete with links to a glossary), volumes in a library, art objects in galleries, and more. For added perspective, the title includes interviews with martial arts gurus. Future Vision provides an abundance of text, narration, and still images as well as a lot of videos showing the various techniques through several different comparative views (video is also used in the help and interview sections).

The Windows-based **Microsoft Automap Road Atlas 4.0**, $39.95, started out as Automap Pro, which Microsoft recently acquired when it purchased Nextbase. The program has fundamentally changed since its purchase. One major change is the addition of the RouteWizard, which eases the process of selecting a route. You select your starting point and destination, and the program calculates your route (you can choose the shortest or fastest or choose roads you prefer). You can specify the number of hours


With Microsoft Automap Road Atlas, you can view the text and map for your route.

QUICK SPINS

$200,000, an animation title will cost $500,000, and a title with video will cost a minimum of $1 million, with some video-intensive titles costing $2 million to $3 million.

- It costs a manufacturer about 50 cents (materials only) to press a CD, according to Dataquest. Other sources indicate the cost is 60 to 70 cents. The cost of packaging a CD-ROM can range anywhere from $1 to $10 for a title with a lot of manuals (an uncommon sight in the multimedia CD-ROM world).
- A manufacturer makes $11 on average per CD-ROM before manufacturing costs.

CD-ROM Tips

- Many programs conflict with drivers for networks, EMS, and screen savers, so keep a boot disk around to make a fresh start in case troubles arise.
- Keep records of the type of hardware components you have in your system (for example, graphics cards, sound cards, CD-

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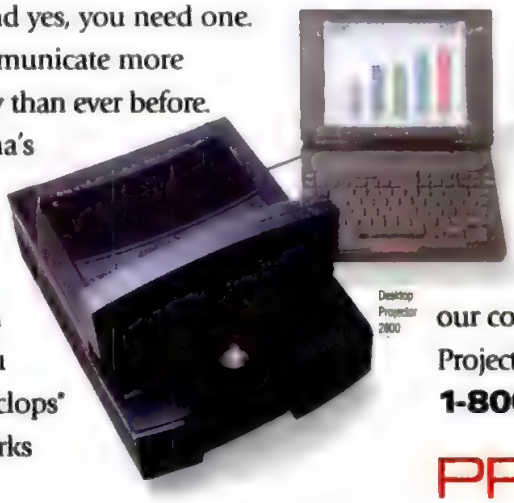

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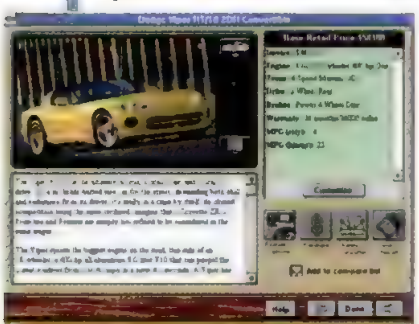
CIRCLE 140 ON READER SERVICE CARD

you'll spend driving each day and your average speed to ensure a sensible route. The final route is displayed in text format and on a map, and you can easily control the level of detail. There's a great deal of detail regarding travel information and points of interest along your route, including airports, parks, rest areas, land and water features, and phone numbers for hotels and car rental companies.

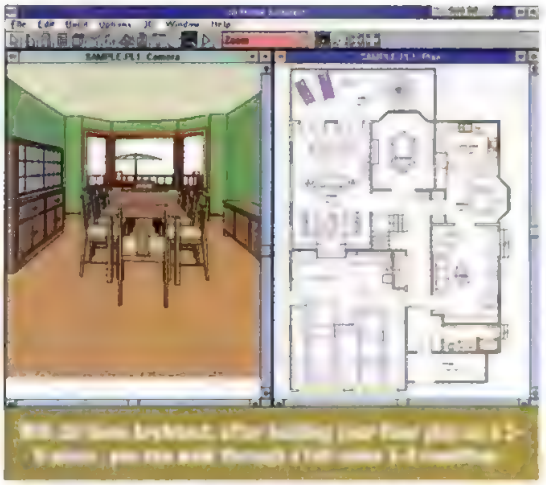
They say the most important part of buying a new car is doing your homework. With **Popular Mechanics New Car Buyers Guide 1995,** $49.95 from Books That Work/Hearst New Media, doing that homework is not only easy, it's fun. The meat-and-potatoes of this Windows-based title is the database of information on over 800 new cars, light trucks, cans, and sports utility vehicles. Detailed stats include dealer cost, MSRP, options lists (with prices), engine and drivetrain specs, warranty information, and more. A photo of each car is also included, as is full-motion video for some.

This trunkload of information is easily searchable. You can generate a stock list of cars grouped by class or produce a list tailored to your preferences. Once your list is generated, you can page through the more detailed screens on each auto, viewing a video clip or photo of the car's interior and exterior (you can even change its colors).



The Popular Mechanics New Car Buyers Guide gives information on over 800 vehicles.

Even the most seasoned traveler needs some help sometimes, and Rand McNally NewMedia's Windows-based **Rand McNally TripMaker**, $79.95, can provide just the right amount. You input your origin and destination, and the package calculates the quickest, shortest, or most scenic route. Click on the Optimized option to have the program calculate the most efficient route if you have many stopovers. You can specify the number of hours you prefer to drive in a day, the speed you'll be driving on different roads (for example, 65 mph for Interstates, 35 mph for state roads), and your anticipated costs (for, say, fuel efficiency). The finished route



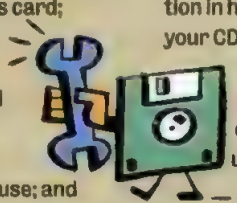
appears in text and map form, and you can alter the route, adding or deleting cities and towns along it. Clicking on the text or the map lets you access a thorough collection of sites to visit, grouped by category: Discovering History, Urban Attractions, Fun for Kids, Airports, Colleges and Universities, and Military Bases for each place. Museums, theaters, and major shopping centers are included. You can pay $19.95 to unlock three more of the attractions modules—on skiing, gambling, and beach destinations, for example—on the CD.

If you've been itching to redesign your kitchen, finish your basement, or add a guest room, Brøderbund Software's Windows-based **3D Home Architect CD-ROM**, estimated street price $70, is the CD-ROM for you. This disk can guide you through the creation of a room or even an entire house, from the studs on up to the living-room furniture, all while adhering to basic architectural guidelines—many of which the average do-it-yourselfer may know nothing about.

The drag-and-drop interface lets you place walls, doors, windows, and more, resize them as necessary, color them, and view the structure in a three-dimensional space that you can (slowly) walk through. The program has been available on floppy disks for a couple of years; the CD version adds a host of common household appliances, fixtures, and other extras in varying sizes and designs. It also adds architectural tips in the form of articles from *American HomeStyle Magazine* and 50 HomePro video clips.

QUICK SPINS

ROM drives); the amount of memory in your PC and on your graphics card; type, address, and IRQ for sound card, MIDI support, CD-ROM, and mouse; and DOS and Windows versions. Have this information in hand when calling your CD-ROM manufacturer's technical-support line. You can use the DOS 6.*x* utility MSD (Microsoft Diagnostics) to get most of the system details you'll need.



- Installing a QuickTime for Windows title might cause your system to crash if you already have a different version of QuickTime on your hard disk. The problem is threefold: Not all vendors use the same versions of QuickTime, not all versions of QuickTime are compatible, and some CDs don't see your existing QuickTime files or prompt you to check if overwriting them is okay. If a CD does indeed overwrite your

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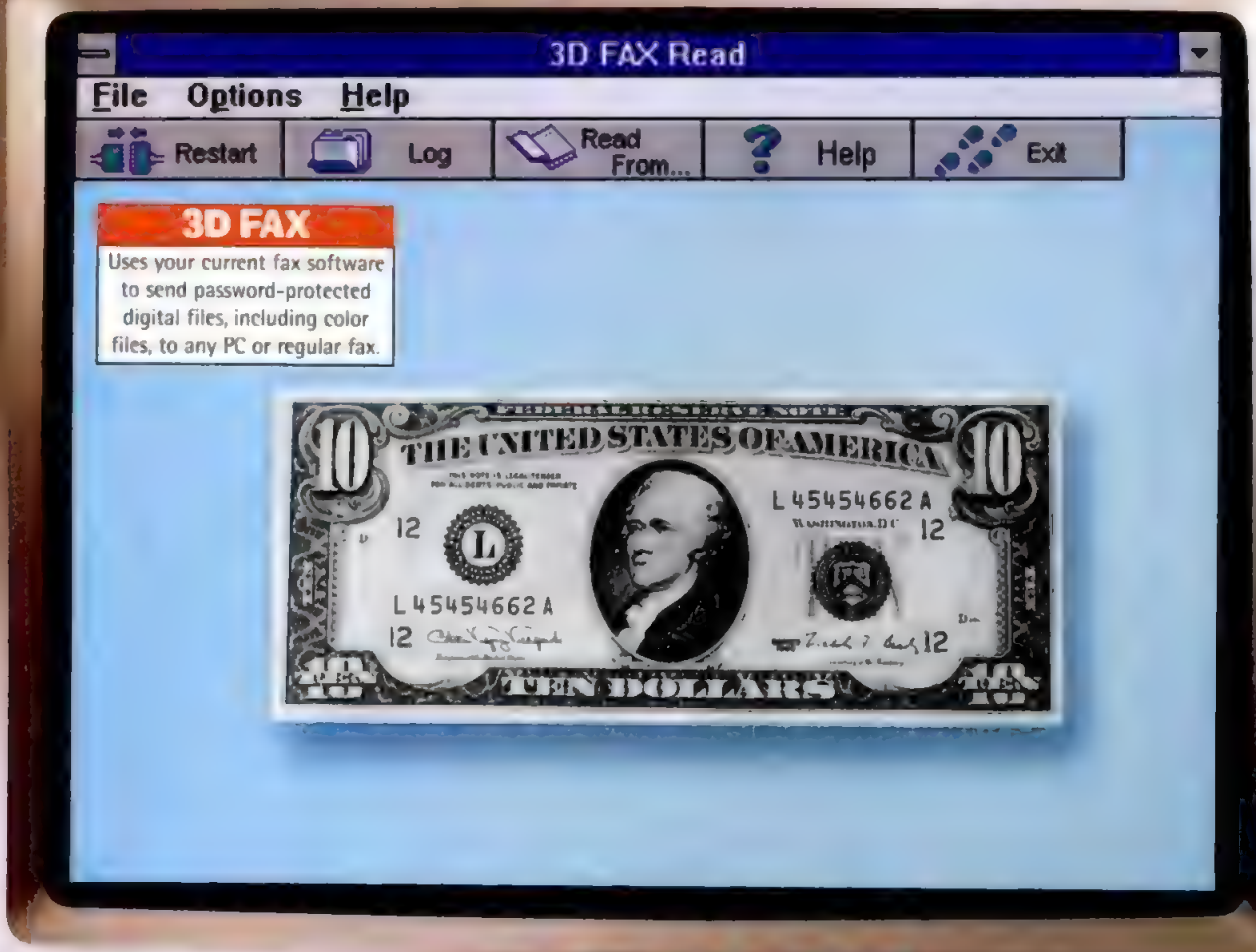
ON YOUR FAX BILLS.



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If you're serious about getting a handle on your health but not so serious that you're willing to hire a nutritionist and a personal trainer, the next best alternative may be SoftKey International's Windows-based **Total Health—Body and Mind,** $79.95. Simply fill in the on-screen questionnaires and the program generates a three-pronged assessment profile in the areas of diet and nutrition, fitness and exercise, and stress management. It then gives you weekly regimens to follow (your "personal health plan") based on your current state of health and tailored to your goals. This nicely executed CD also provides a range of background material in the three areas, as well as a guide to fitness activities and sports, a section on controlling your weight, and a glossary.

DíAMAR Interactive Corp.'s **Understanding Exposure: How to Shoot Great Photographs**, $59.95 ($79.95 with a companion book), is a big help for novice and professional photographers alike, and a fascinating use of CD-ROM technology, too. Photography expert Bryan Peterson provides tables of formulas on such considerations as lens choice and film speed. This Windows/ Mac hybrid includes the Interactive Theater, which presents half-hour to one-hour

demos on several topics; Workshops, which let you personalize your lesson; and PhotoLabs, where you can experiment with aperture, shutter speed, and film speed. The latter section is especially impressive: The photograph changes before your eyes, and you really get a feel for the effect of each choice.

For the
KIDS' ROOM

From the day they're born, children are drawn to bright, high-contrast colors, funny sounds, and frenetic movement; it's how they learn.The following CD-ROMs belong in the kids' room because they, too, combine brilliant animations, funny sounds, engaging movement, and quite often an educational message.

Science for Kids' **Adventures with OSLO Tools and Gadgets,** $59.95, is an informative, fun CD for kids ages 5 through 14 who are interested in basic principles of mechanics. The program successfully aims at a range of ages by offering activities suited for different learning levels. Greeting you at the start is OSLO the Robotron, with bright buttons that lead to different areas of the program. There's an arcade-type game with balls that fall down through a maze, and the Coloring Gallery lets the young painter pick from a selection of crayons, markers, and colors. You can also work your way through demonstrations of the mechanics behind such tools as wedges, wheels, screws, and inclined planes. There's also an interactive animated story in which you have the chance to save Dolly the llama from disaster. You must, however, select the right tools to pluck her out of the refrigerator or satellite dish. The CD is a Windows/Macintosh hybrid.

Brøderbund Software's **Alien Tales,** estimated street price $45, is a Windows-based galactic game show that pits kids ages 9 to 13 against a series of alien contestants posing as the authors of 30 classic and contemporary works of children's' literature. The goal is to defeat these impostors, and in the process win a book back for earth and make the universe safe for all authors. To advance, players an-

QUICK SPINS

existing version of QuickTime, the CDs that use that version won't work. Version 1.1 isn't backwards-compatible, and until recently Version 2.0's backwards compatibility was limited. An upgrade to 2.0, Version 2.01, resolves those limitations and is available on CompuServe at GO:MACMEDIA. But the reality is that there are still plenty of titles with different versions of QuickTime, and you'll have to be on your toes if you're to keep on top of all the versions on your system. Consider removing all QuickTime files before installing a new title unless you're sure that all your titles (including the new one) use the same version.

- Some CD-ROMs are optimized for double-speed CD-ROM drives or better and won't run well (or at all) on a single-speed drive.
- To run many graphics-oriented DOS games, your graphics card must support VESA mode. VESA drivers

swer a series of true/false questions and fill in crossword and acrostic puzzles using information gleaned from reading such books as *The Wizard of Oz, Charlotte's Web, and The Secret Garden.*

In Simon and Schuster Interactive's **Alistair And The Alien Invasion,** $49.95, Alistair is an English schoolboy who irons his socks and shoelaces and says things like, "This is most unsettling." His cartoon world is drawn appealingly with chunky shapes and primary colors. The Read to Me section is just a narrated story; the Read and Explore section is more fun: You interact with Alistair's world as if it were a dollhouse in which everything you touch turns to life. Click an apple and a worm pops out to say "Hey!" in a gruff voice. There is a handy scroll bar for getting around, and setup is easy. The Windows-based title is geared toward children ages 5 to 10.

Counting On Frank, from ABC/EA Home Software, $49.95, is an extremely entertaining math game for kids ages 8 to 12. You are Henry, a boy with a math-loving dog named Frank. Your mission is to help Henry and Frank win the local jellybean-counting contest by solving math problems and collecting clues.

The graphics are vivid and amusing, and there are many hot-spot animations that are so much fun that kids may forget to search for clues. Still, if they get past the desire to make Frank chew bubble gum continuously, kids will find real-world math problems presented in an engaging, nonthreatening manner that encourages thought and reasoning over speed and arcade skills. Parents will appreciate the fact that they can select the level of difficulty for the problems and that the program can run straight off the CD-ROM, which is a Windows/Macintosh hybrid.

Micrografx's Windows-based **Crayola Amazing Art Adventure** and **Crayola Art Studio,** estimated street price $40 each, offer a friendly and colorful

In Crayola Amazing Art Adventure, you can explore your options by just gliding your cursor around the room.

way for your child to flex his artistic muscles. And they offer you a break from marks and scribbles on the wall. Intended for kids ages 3 to 6 and 6 to 12, respectively, the programs share basic tools and an interface metaphor: Projects are represented as toys and desk accessories, all strewn about a room. All your child has to do is point and click to draw, solve puzzles, and see hot-spot animations.

Where the programs differ is in the focus and complexity of their content. Art Adventure has fatter crayon, marker, and brush tips, and focuses on coloring-book pages and simple puzzles. Art Studio, on the other hand, adds more control over nib and brush size, more special-effects filters to apply to drawings, a slide-show/movie utility, and projects (such as Certificate Maker) aimed toward an older child with solid reading abilities . Both programs have stickers (which work just like object layers in Micrografx's Picture Publisher) and animated actors, and both share the Gallery area, where you store completed works.

Discovering Endangered Wildlife lets you pick a species to "save."

Lyriq International Corp.'s **Discovering Endangered Wildlife,** $39.95, meshes nifty games and multimedia instruction to attract youngsters to a vital message: For countless animals, the only hope of survival is a far more humane attitude among humans. The Na-

place the resolution of a DOS screen in SVGA mode.

- Several CD-ROMs focus on providing you with multimedia and CD-ROM tips. Check out the $29.95 Basics and Beyond: The Complete Interactive Guide to Multimedia Computers from Frank Kasper and Assoc. (612-942-0566) and the $29.95 Professor Multimedia, Version 2.0, from Individual Software (510-734-6767).
- A great reference tool is CD-ROMs in Print 1995 from Mecklermedia (203-226-6967). The $49.95 package provides a comprehensive list (updated twice a year) of CD-ROMs on the market; you can search the list by category, title, and so on.

- Interactive Catalog Corp.'s Multimedia Know-It-All (206-623-

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tional Wildlife Federation endorses this Windows package and also receives one percent of the revenues from its sales.

In the clever opening animation, visitors from the future beg for help in rescuing species that have not survived into their era. The user "restores" one species at a time by completing simple crosswords, memory games, and other puzzles, learning all about an animal in the process. Clues are available, along with realistic sound and video clips. If you fail to complete a puzzle on your first attempt, the program gives you more time for your next two tries; if you fail after that, the program solves the puzzle for you.

Humongous Entertainment's Windows-based **Freddi Fish and the Case of the Missing Kelp Seeds,** estimated street price $40, is graphically brilliant and full of sounds children will love, such as "bloop" and "blat." Like all good children's programming, Freddi Fish also attempts to teach lessons and sharpen skills; this title concentrates on problem solving and critical thinking ("Oh, I need a bright light. Now where did I see that bright light? I'll have to go back and find it so I can trade it for the fishing pole I need"). Kids will love the screens full of clickable items; some hot spots provide clues to help find the kelp seeds, and others move and make great noises. The colors are brilliant and the animation is excellent, down to the quirky mannerisms of Freddi and his friend Luther. The product is intended for kids 3 and up.

It's easy to read along with Living Books' **Harry and the Haunted House,** estimated street price $40. While Harry and his friends play baseball one day, they accidentally bat the ball into the window of a haunted house. They're compelled to search the rooms for the ball, and throughout the house they get spooked time and time again (although it's just a bump or a scratch that sends them shivering). In each scene, you're given a narrated animation with the words from the story at the top. You can click on any object in a scene to get some surprise. The countless animations in this Windows CD will keep kids interested for ages. A Spanish version of the story is included.

Building a Successful Kids' CD-ROM: Lenny's Time Machine

PRINT CAPABILITY: Young ones may want to study the entertaining images they've seen or read the included text more closely

VIVID GRAPHICS: Bright colors and richly drawn graphics are the linchpins of a successful kids' title

IDENTIFIABLE CHARACTERS: One look at Lenny the Penguin and you know that kids will instantly spot him in every screen

INTUITIVE INTERFACE: Don't expect kids to read the manual. They want to dive right in and know exactly where they're going

LOTS OF SOUND EFFECTS: Fill your screen with hidden sounds. If a kid clicks on a horn, he had better hear it play back a little tune

ENTERTAINING GAMES AND ACTIVITIES: Goofing off has its merits, too. Don't try to teach kids at every turn. Give them a blend of education and some stuff that has nothing to do with learning

WITTY, HOT-SPOT ANIMATION: Little id-oriented kids demand instant gratification. If they click on the fan in Lenny the Penguin's hands they expect it to wave. And here, as in any good kids' title, it does

AGE-APPROPRIATE EDUFACTS AND INFORMATION: Remember your audience. Children are an inquisitive bunch, but if you talk over their heads or present information that's too strong for young audiences, you'll lose them in an instant

CREATIVITY TOOLS: The funny thing about kids is that they'll decide they want to create in the middle of almost anything. Have the tools to satisfy that impulse standing by

ON-LINE HELP: The worst thing you can do is leave kids hanging. If they get lost in your entertaining interface, you'd better have help waiting to bail them out

INTERESTING MUSIC: To keep youngsters' attention, you need a bright, fast-paced score

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In My First Encyclopedia, kids can scroll on the tree, accessing geology at the roots and astronomy in the branches.

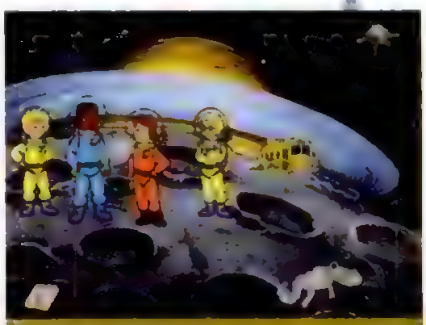
Viacom New Media's DOS-based **How Things Work in Busytown,** $49.95, features a town populated by charming Richard Scarry characters, such as Hilda Hippo and Huckle Cat, who help kids ages 3 to 6 learn what it takes to keep a community running. Kids will have hours of fun exploring this beautifully animated town, where the denizens must complete everyday tasks such as collecting the garbage, baking bread, and repairing the machines that make it all possible. Perhaps the most important lesson this program teaches young citizens is that all the activities are interrelated: Before Hilda Hippo can bake bread, she needs wheat from the mill.

In Windows-based Viacom New Media's **Lenny's Multimedia Circus,** $49.95, and **Lenny's Time Machine,** $49.95, we find Lenny under the big top and traveling through time, respectively. Lenny, who made his debut in Lenny's MusicToons (one of last year's Top 100 CDs), may seem a ringmaster of mirth in the circus adventure, but the many games and activities are also educational. While they're directing the comical circus acts, kids are also learning about the principles of weight and force. All the usual circus attractions are here, including the midway, the big top, and the souvenir stand. Kids can indulge in face painting, Skill Ball, and Horse Racing. To teach kids how to use money, the package lets them buy souvenirs and post cards.

In Lenny's Time Machine, the sushi-loving penguin takes a time-traveling adventure that is both stimulating and sensational. In it, young explorers span the world and cross the boundaries of time with Lenny and his Time Machine. The emphasis here is on learning history through exploration rather than through drill-and-skill activities.

Microsoft Corp.'s Windows-based **Magic School Bus Explores the Solar System,** estimated street price $50, provides a snappy blend of education and entertainment. Before you begin the interplanetary adventure, you start off in the comfortable setting of a science classroom, with the sprightly teacher and students of the PBS series and the Scholastic book series of the same name. Click anywhere in the room and you might see a goldfish that does gymnastics or a science project that actually explodes. There's a lot of attention to interactive detail and a helpful lizard icon as well. Once you're in outer space, stunning videos and facts are interspersed with different activities, such as making your own craters on the moon or playing Saturn's rings like a phonograph.

With Novell Corp.'s Windows-based **Memphis Math: Treasure of the Tombs,** $49.95, kids 8 to 14 can unravel a mystery that takes them to the Sphinx, the Pyramids at Giza, and the Mortuary Temple of Hatshepsut—all while they're learning about decimals, fractions, and percentages. The goal is to solve math problems in each of these locales to earn ancient Egyptian artifacts and pieces of the Sacred Scarab. All the sights are beautifully rendered in high-color graphics with a 3-D look that you simply point and click around to explore.



In the Magic School Bus Explores the Solar System, facts are interjected amid fun.

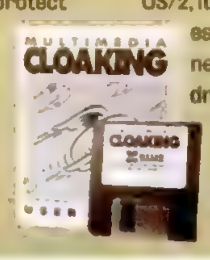
Microsoft Corp.'s Windows-based **Microsoft Dangerous Creatures,** $59.95, is a single-subject reference work that helps bring the world of the predator alive for kids ages 8 and up. All it takes is a simple point and click to uncover a video clip of a cheetah stalking its prey or, on a friendlier note, baby grizzlies at play. With over 800 articles, hundreds of photos, and more than 100 video clips, there's plenty of mul-

QUICK SPINS

0977) is a catalog of multimedia products and includes a browser, pricing information, comparative reviews, and product demos. The list price is $14.95 for an issue or $29.95 for a one-year subscription.

CD-ROM Gear

- The best thing to happen to CD-ROMs is Multimedia Cloaking, Version 1.0, from Helix Software Co. (718-392-3100). Using a small conventional memory stub, Multimedia Cloaking lets you run Helix's version of MSCDEX, mouse driver, and cache in 32-bit protect mode so you don't lose all of your conventional memory or upper memory blocks (UMBs). For those not running NT or OS/2, it's really a savior—especially if you also need to load network drivers. The list price is $39.95.



- The Packard Bell Multimedia line, from Packard Bell

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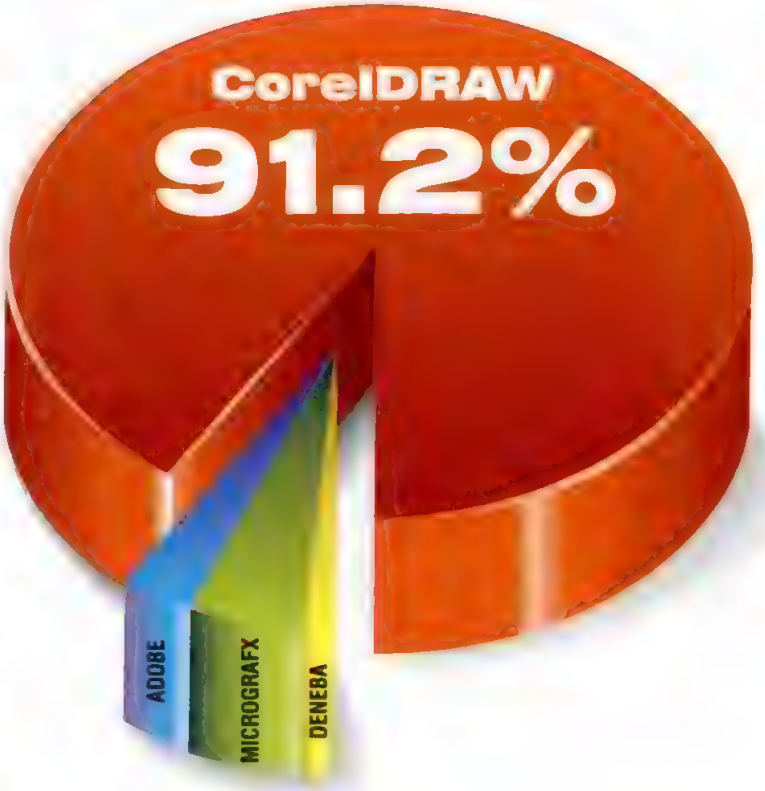
[illegible]	257	73,968.64
Micrografx	380	36,696.38
Deneba	98	15,899.24
Totals	8,344	1,713,083.90



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3.5" disk version

INFOWORLD
Report Card Rating,
Desktop Publishing Software
March 20, 1995

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PC World,
Best Buy Award,
April, 1995

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CIRCLE 322 ON READER SERVICE CARD

timedia attraction here, and it's all first-rate. If exploring on your own seems a bit intimidating, you can try one of the narrated, guided tours that let you explore some of the regions where these predators live.

Need some time to yourself? Send the kids over to Thaddeus Pole's (Tad for short) space ship and let them zoom around the world of nature for a couple of hours. In Microsoft Corp.'s **Microsoft Explorapedia: World of Nature,** estimated street price $35, there's plenty to keep the kids busy, and lots to learn in an easily navigable, feature-rich environment. With Tad—a rather hapless and goofily angst-ridden frog—as their guide, children can explore rain forests, deserts, savannahs, outer space, wetlands, rivers, lakes, and more, all without fear of getting hopelessly lost. Tad is always on hand in the corner of the screen, ready to offer help, answer questions, lead you to a new locale, show more information about a topic, or return you to the ship with a click of the mouse.

And here's a dreamy-looking tree house that looks as if it were transplanted from an old-fashioned story book—but this is one that you can scroll up and down from roots to treetop. The advantage of Knowledge Adventure's Windows-based **My First Encyclopedia,** estimated street price $35 to $45, is that you can jump from topic to topic. Move from astronomy in the tree tops to geology in the roots, and investigate the many subjects, games, and activities from top to bottom. Click on a vehicle to find out how it moves, then color it in. Create a wild animal, give it a name, and hear it pronounced. Hear over 30 pieces of regional music. The explanations are basic (the CD is for ages 3 to 6) but sufficient for this ever-curious age group.

My First Incredible, Amazing Dictionary

My First Incredible, Amazing Dictionary from DK Multimedia, $39.95, features about 1,000 gorgeous drawings and words arranged alphabetically. When you click on a drawing it enlarges and a screen appears with the word and its definition. Either the word or its definition can be spoken, and often the definition screen contains icons that let you proceed to related words. For example, the Rain screen has an icon that you use to access all the

words related to weather. What sets this Windows-based dictionary apart is the excellence of the art, the animations, and the sound.

Viacom New Media's DOS-based **Nickelodeon Director's Lab,** $59.99, can keep you or your kids occupied for hours. In the lab, you create your own multimedia video with graphics, video, music, sound effects, and titles in countless combinations. The video is built on a time line with separate tracks for each area; select from libraries of existing elements, such as sounds and characters from Nickelodeon programs and videos of Bush or Clinton. Narration and instructional videos are provided by Clarissa Darling (Melissa Joan Hart of Nickelodeon's "Clarissa Explains It All").

MECC's **Oregon Trail II,** $58, a remake of the original Oregon Trail title, brings the westward expansion alive for kids 10 and up through the use of multimedia. This interactive simulation lets young explorers experience the hardships early settlers endured on the American frontier through video, sound effects, and digitized speech.

Kids create their own characters, choosing an occupation and skill set; the decisions they make here influence the amount of money they have and how likely they are to succeed. Next, it's time to choose a wagon party, stock up on supplies, then hit the road. The party will stop at rivers and other major landmarks along the way, seeing beautifully illustrated sights and meeting interesting people. They'll also be faced with delays and disasters that hinder their progress toward the

QUICK SPINS

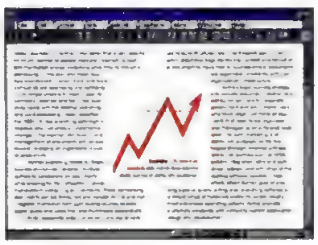
Electronics (818-865-1555), includes a system with two CD-ROM drives so you can run two CD-ROMs at the same time. The same system includes software that hunts between the two drives. For example, if you install a game in your D: drive and the CD is actually in E:, it still plays. Depending on how a CD application is written, two-disk CD software might be able to use this feature automatically. (price with two CDs: $1,199).

● CD-ROM changers are indispensable for avid CD-ROM users. Check out Pioneer New Media Technologies' Pioneer DRM-604X and Mountain Network Solutions' Mountain CD7 (see "The Newest Spin on CD-ROM Drives," March 28, 1995). The Pioneer is a quad-speed 6-disk changer (list price $995); the Mountain is a double-speed 7-disk changer (list

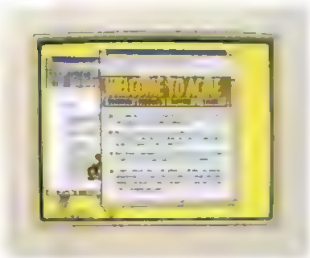
A YEAR IN THE LIFE OF A FRAMEMAKER DOCUMENT.

JAN 14 *Acme Development Company's marketing department worked as a team to create its first marketing plan. Everyone contributed, each using FrameMaker's text, graphics, layout, formatting, and long document features. The end result was the best marketing plan in Acme history.*

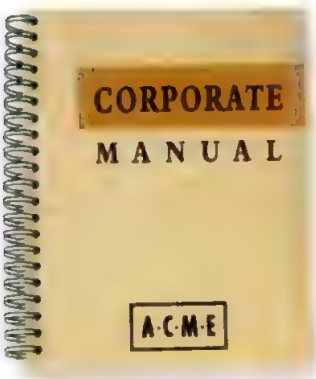
SEP 27 *Oops! Fido just made a meal out of some essential drawings. Fortunately, FrameMaker can import directly from the architect's workstation, since it supports popular CAD, graphic, and word processing file formats. It even runs on platforms like Macintosh, UNIX, and Windows.*



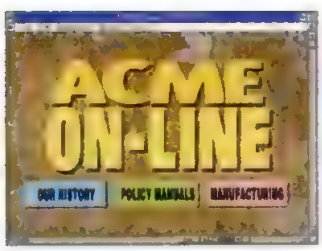
MAR 28 *Business was booming, so Acme included its skyrocketing sales figures in the marketing plan. FrameMaker imported a variety of graphics, and flowed text neatly around them with the help of the new auto text wrap feature. It even has unsurpassed table editing for multipage tables.*



DEC 3 *Soon Acme had its very own Web site to help disseminate company information to employees and customers all over the world. So naturally, Acme made extensive use of FrameMaker's new HTML export capabilities. Now all its material could be published directly to the Internet.*



MAY 10 *Acme hit the bigtime and went public, becoming Acme Corporation. To make sure all the IPO documentation was consistent, FrameMaker's import text and graphics by reference feature was used extensively for retrieval and update of boilerplate information created in FrameMaker or other applications.*



JUL 1 *Suddenly Acme had a need to communicate online—to save time, paper, and even a few trees. So they used FrameViewer™ for instant online distribution with no additional post-processing or conversion required. It even supports FrameMaker's automatically generated hypertext links.*

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CIRCLE 105 ON READER SERVICE CARD

New Territories, and tough problems to figure out. The title is a Windows/ Macintosh hybrid.

Videodiscovery's **Science Sleuths,** $59.95, an imaginative science CD-ROM, is aimed at older juveniles. It indulges in the requisite number of geek jokes to help you get past the fact that you're learning about science. But most of the time it takes the scientific method seriously, and to good effect. You work in a detective's office/lab with a wisecracking but supportive guide. In an extended tutorial, she shows you around the digs, explaining what kinds of mysteries you'll come across and what resources and tools exist in the laboratory to help you crack the cases—you'll depend most strongly on empirical evidence, naturally. There are two cases to solve, each with six levels of difficulty. This Windows-based CD is full of high-quality video and other multimedia extras to help you along.

Brøderbund Software's Windows-based **Where in the World is Carmen Sandiego?, Junior Detective Edition,** estimated street price $40, is a simpler version, designed for kids 5 to 8, of the original game. The object is to find and capture one of Carmen's nasty cohorts. You answer clues that move you from country to country in search of the villain (the villains have names like Manny Miztakes and Tip Dover). You get a picture of a scene representing a country, and you click on the scene with your magnifying glass. When the magnifying glass lights up, you call up the clue. An animated figure tells you the clue and provides an icon (such as the flag of Panama) to help you solve the mystery. Meanwhile, you receive parts—and eventually all—of a picture of the bandit, and after you work through all the clues, you watch an animation in which the bad guy is captured. Because of the visual cues and easy interface, the title is perfect for the younger child just learning to read. A Windows/Macintosh hybrid version of the CD is available.

In Science Sleuths, you use lab tools to solve the Mystery of the Exploding Lawnmowers.

For the
REC ROOM

Push aside the table and get ready to rumble! Well, actually, keep the table where it is, turn on your PC and get ready to experience rumbles, explosions, and fights, as well as tests of skill, nerve, and intuition with our collection of the multimedia market's game and entertainment CD-ROMs—any of which should fit quite nicely into your recreation room *without* moving the furniture.

There's a lot to like about **Bob Dylan: Highway 61 Interactive**, $59.95, Graphix Zone's lovingly crafted tribute to Bob Dylan's career. The interface—a sort of beat-generation coffee house/cafe—is original, and it represents the best of this genre of CD. The disk runs on Windows and Mac systems.

Click on the guitar to see song and album information and a picture of the album cover. A time line gives you the story of the artist's life and career, along with an array of pictures. Hot spots abound and can lead to just about anything. Clicking on the tambourine calls up "Mr. Tambourine Man." Highlights such as Dylan's 30th anniversary concert and early critical reviews combine to form an intriguing, touching retrospective. If only you could turn back the clock.

QUICK SPINS

price $599). A double-speed 6-disk changer and quad-speed 18-disk changer are also available from Pioneer.

- Gateway 2000 (800-846-2000, 605-232-2000) has started including CD-ROM changers in some of its systems. The Gateway 2000 P5-120, a 120-MHz Pentium machine, comes with a quad-speed 3-disk CD changer. The PC costs $3,999.
- Multimedia upgrades from hardware vendors are turning home PCs into multimedia workhorses. Diamond Multimedia Systems' SOHO Kit 6000, Educator Kit 3000, and Games Kit 2000, for example, have quad-speed CD-ROM drives, CD-ROM titles, 16-bit stereo sound cards, speakers, installation videos, and manuals for an estimated retail price of $399. Keep your eyes peeled for other good buys.
- Opti-Net and Opti-Net NLM software from Reed Technology and Information Services let your networked Windows

In **Chuck Jones' Peter and the Wolf**, a $29.95 Windows/Macintosh hybrid from Time Warner Interactive, the animation legend combines animated versions of Peter, his friends the duck and the bird, and that dreadful lupine fellow with Prokofiev's famous score. The sub-Alpine landscape and the banterings of the little animals (Kirstie Alley is the voice behind some of the characters) should prove delightful to most children and adults. The animation is good, the score terrific, and the story time-honored. You get background information on the artist and composer, along with some explanation of the composition and animation. For example, the CD explains that each character is played by a different instrument.

LucasArts Entertainment Company's **Dark Forces**, estimated street price $55, has it all. Imagine everything you loved about the Star Wars films: fantastic adventure, intense action, a complex plot, and a powerful musical score. More than just another shoot-em-up DOOM clone, the DOS-based Dark Forces demands some serious puzzle-solving skill to get through it. Of course, it doesn't hurt to have a fast blaster, especially when the Empire's Dark Troopers show their Terminator-like faces. You play a Rebel agent whose mission is to eliminate these Troopers to save the Alliance. Thanks in part to the game's stunning graphics, sound effects, and music, you'll gladly accept the job.

To keep up in Dark Forces, you have to be clever.

Dazzeloids, $39.95 from the Voyager Company, is everything a kids' entertainment disk should be: humorous, whimsical, educational, cool, music-filled, and eclectic. Kids will be mesmerized by this Windows/Mac hybrid CD. The Dazzeloids are a group of hysterically adorable cartoon characters with loads of depth and movement. They're heroes in two interactive books including "A Child is Bored," a story about a kid who watches too much TV. Both stories (there's also a music-video sequence) have a great sound track, dozens of wacky interactions, and even a bit of a moral lesson. Rodney Alan Greenblatt, the creator, understands this medium better than any other kids' author.

Aliens have raised Hell on Earth in GT Interactive Software/id Software's **DOOM II**, estimated street price $39 to $49, and DOOM addicts are asked once again to exterminate the aliens before Earth is lost. DOOM II provides more of the same excitement gamers got in the original DOOM. The DOS-based CD's fast-paced action, violent images, and gory details can provide gamers with hours of engaging entertainment. Just make sure you have the time to spend, since you can easily lose yourself inside the various levels.

The "A Child is Bored" section of The Voyager's Dazzeloids CD-ROM is a whimsical tale.

Flash Traffic City of Angels, $29.95 from Time Warner Interactive, is a high-testosterone, DOS-based interactive live-action game that comes on three CDs. A city laboratory has been busted by the Drug Enforcement Administration, but it turns out to be a nuclear bomb factory. Your assignment as a wise-cracking FBI agent is to guide your team through questioning suspects, investigating locations, and finally, disarming a nuclear bomb. At any point the wrong decision could blow up in your face, literally. You determine the path the story takes (there are several to follow), making each game new and exciting. The game's violence and situations make it appropriate only for adults.

Gaming goes cyberpunk with Sony Imagesoft's **Johnny Mnemonic**, $69.95, a title based on a story from William Gibson. This one really does deserve the designation "interactive movie": It's essentially a movie filmed as a computer game. There's no change in interface from the movie sequences to the interactive sequences; the video window changes only slightly to indicate that the player is faced with a "Window of Opportunity."

In this two-disk narrative adventure, the player is cast as Johnny Mnemonic, a data courier who holds some very valuable information stored on a chip in his head. Unfortunately for Johnny, the data he car-

and DOS users share CD-ROM drives and multimedia applications. Users share CD-ROM software in the same way they share files on networks, thereby gaining fast, convenient access to CD-ROM-based data, applications, and multimedia. By using Opti-Net, you can avoid equipping each network workstation with its own CD-ROM drive and software. An 8-workstation license is $795; a 100-workstation license is $1,495.

● CD Essentials, a Windows-based utility from Phoenix Technologies (800-452-0120), automates the process of launching CD-ROM programs or media players, guides you through installations, and uses hot keys for ejecting CDs. WinDelete, the company's uninstall utility, is included. The street price is $35.

Shovelware

Some publishers insist on churning out mounds of data and heaping it onto CD-ROMs. Despite their great potential, CDs can be sloppily edited and have poor content. Watch your step.

● Chestnut's The CIA Papers

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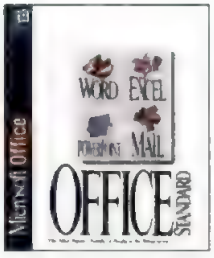

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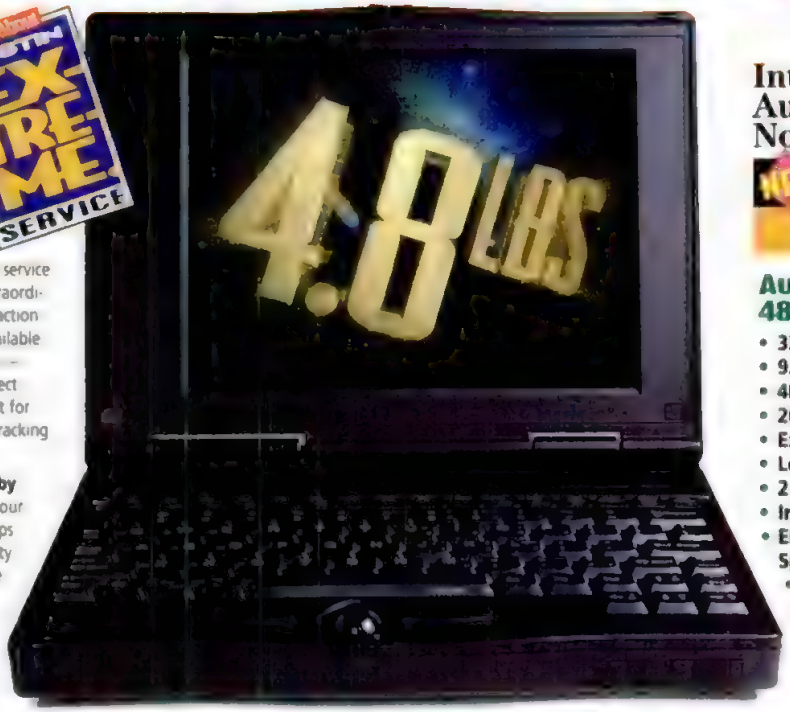

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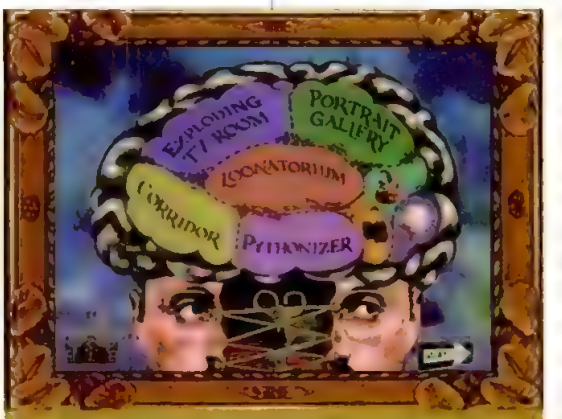
CIRCLE 012 ON READER SERVICE CARD

ries exceeds his memory capacity, and he doesn't have the download code. The player's goal, then, is to find the pieces of the code so Johnny can download the data before he dies, or before someone decapitates him.

Microsoft Cinemania '95, $59.95, continues to build on its already established strengths as the best Windows-based movie CD-ROM available today by offering a one-stop solution for film and video buffs. There are plenty of sound clips of varying lengths, and enough new video clips from favorite films to whet your appetite (and make you wish they had more). Reviews are provided by such notable personalities as Leonard Maltin, Roger Ebert, and Pauline Kael.



Monty Python's Complete Waste of Time is as exquisitely pointless as its title suggests.

Any real basketball fan should be ashamed not to own Microsoft's Windows-based **Microsoft Complete NBA Basketball**, $49.95. It contains an incredible wealth of information (both biographical and statistical) about players, teams, coaches, and more. There's a nice collection of videos of famous players and great games. By default, the program randomly plays sound bites of outstanding games. Hypertext links pervade the product. Virtually every time another player, team, year, or statistical category is mentioned, it's also linkable, letting you wander about for hours.

Not so long ago, computers were considered serious tools for business (a harumph is implied here). **Monty Python's Complete Waste of Time**, $49.99 from 7th Level, makes you realize how entertaining your PC can be. This Windows-based CD presents a visual and aural tapestry (troupe-member Terry Gilliam is the cocreator/executive producer and offers his original art), which is as exquisitely pointless as it claims to be. In this interactive collage, you might click on cut-out dancing girls only to see them doing wild chorus-line kicks and breaking wind. Some familiarity with Monty Python's brand of humor enhances the experience, because this CD-ROM includes many snippets of dialog from the old skits, and the laugh track might make you feel left out if you don't recognize them.

One of the best things about the DOS-based **MTV's Club Dead**, $59.99 from Viacom New Media, is its "invisible" interface. You're Sam Frost, former inmate at the Metacorp Prison and a virtual reality (VR) enthusiast. The directors of the Metacorp Company have taken you out of prison to be cyberplumber at The Alexandria, their "Hotel for the Mind," a VR playground for the rich and famous where patrons are dying off at an alarming rate. Your goal is to use your special electronic tools to elude the bad guys and keep the visitors from keeling over.

The story is compelling, the mystery difficult to crack, and the characters oddball and developed enough to keep you playing.

With the realistic sounds and excellent 3-D graphics of Papyrus Design Group's **NASCAR Racing**, $50, you can almost smell the rubber burning. This DOS-based CD lets you choose from one of nine tracks, and you can race a single day or put together a full-season circuit. There's even a multiplayer option that lets two of you compete (via a modem or direct connection) in the same race.

The pleasure of a good hockey game doesn't have to end with the season. **NHL Hockey '95**, $59.95 from Electronic Arts, brings the hard-hitting action home to your PC. Every detail of this DOS-based game makes the rough and tumble activity of playing hockey an exhilarating experience. The sounds of the hard checks and goal shots are sharp and clear. And the game displays entertaining animation when spectacular plays are made; it also provides instant replays.

Relentless: Twinsen's Adventures, $59.95 from Electronic Arts, has so many outstanding qualities

QUICK SPINS

is merely stretches of undistinguished text and nonfunctioning video.

- The offensive images from The Holocaust, from Quanta Press, lack both humanity and perspective. The pictures are shocking, but so is the lack of historical information needed to try to explain how and why the Nazis exterminated six million Jews.

The Best Apps on CD-ROM

With these products you get the convenience of fast, easy installation (no stacks of floppy disks) and the pleasure of useful extras.

- Adobe Photoshop, Adobe Systems ($895).
- Corel DRAW, Version 5, Corel Corp. ($695).
- Lotus 1-2-3 Release 5 for Windows: Multimedia Edition, Lotus Development Corp. (Estimated retail price, $329).
- Lotus NotesSuite Release 1.1, Lotus Develop-

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BARBADOS 64
64-bit VRAM acceleration
1600 x 1200 resolution
16.8 million colors
PCI Bus

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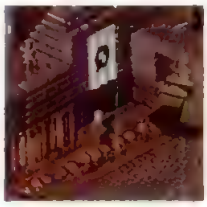
CIRCLE 167 ON READER SERVICE CARD

that they're difficult to list. In this challenging and humorous DOS-based adventure, you must help little Twinsen save the world from the evil clutches of Dr. Funfrock. The game's vibrant, beautifully rendered graphics and fabulous sound track will draw you into the adventure and keep you there until it's finished. The innovative interface gives you control of Twinsen's attitude as well as his movements.. It may take you a while to master the art of controlling our hero, but the time is well spent.

When you first enter the big top at The Voyager Company's **The Residents Freak Show**, $49.95, you find an ordinary sideshow (there's an oxymoron) complete with Mickey the Mumbling Midget, Wanda the Worm Woman, and a barker named Tex. But venture behind the tent and into the dark trailers where they live and you'll learn each one's story and secrets from animated shorts, letters, photo albums, paintings, The Residents' songs, and the characters themselves.

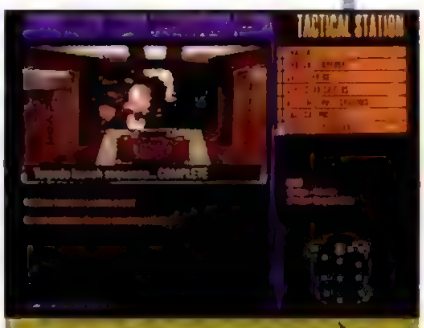
Fans of the band The Residents will delight in the included short films, old and new songs, and concert footage stretching back to the band's early years. The CD is a Windows/Macintosh hybrid.

SimCity 2000 CD Collection, $70, makes you the mayor of a bustling city. The package includes the game SimCITY 2000; Scenarios, Volume One (Great Disasters); and the Urban Renewal Kit, which, for example, lets players change the appearance of their buildings. Everything about Maxis's DOS-based game is at your discretion: all facets of city management, from trash collection and postal services to parks management. Be careful if the Sims, the simulated people of the city, aren't happy; they may riot and throw you out of office. The tools necessary to do your job are intuitive, though you might on occasion need to refer to the manuals. Each time you play SimCity you have better insight into the challenges civic leaders face. At press time, a Windows version had just been released, and a Macintosh version was expected soon.



Relentless: Twinsen's Adventures is challenging.

If the sports page is the first section you read every morning, then the **Sports Illustrated Multimedia Almanac, 1995 Edition,** $39.95 from StarPress Multimedia, is for you. This easy-to-use almanac, a Windows/Macintosh hybrid, provides a complete history for the past year and a half of sports, from football to horse racing, including details of 18 amateur and professional sports. The CD combines sharp and colorful images with detailed facts and figures from the '94 season. Every issue of Sports Illustrated from October '93 to September '94, the year in review with more videos, and a gallery of colorful photos that appeared in the magazine with the corresponding articles.



Star Trek: The Next Generation Interactive Technical Manual has scads of ship specs.

Star Trek: The Next Generation Interactive Technical Manual, $69.95 from Simon and Schuster Interactive, successfully straddles that delicate line between nerd-intensive and multimedia-maniacal. The Windows-based CD, noted for being the first to implement the Apple Computer QuickTime VR codec, lets you walk through various places on the ship. You can go on a tour (Commander Riker is your guide) or explore on your own, selecting a location. Browse through the Captain's Quarters, Ten Forward, the Bridge, and the Ready Room, or look at an external view of the ship.

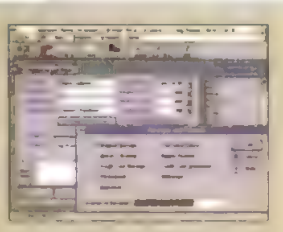
If you are quick at making decisions and love competition, test your abilities at MicroProse Software's **Transport Tycoon**, estimated street price $58. You're the president of a new transportation company and you're asked to build your enterprise into an empire. In this DOS-based game—populated with detailed, animated imagery, music, and sound effects—you can build roads, rails, airports, bridges, tunnels, and the like, and you must purchase and maintain your company's transport vehicles. The package tracks your profit margins, even providing details on the earnings for each vehicle, and can graph the numbers against those of your competition.

The film noir detective mystery, **Under a Killing**

QUICK SPINS

ment Corp. ($499 for combined client license of Notes and SmartSuite).

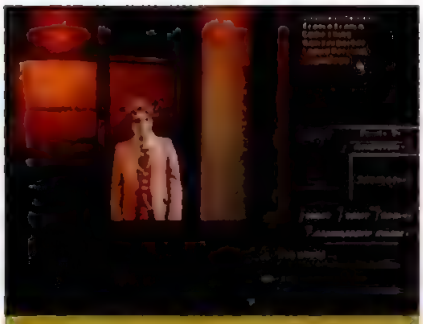
- Lotus SmartSuite, Lotus Development Corp. (Estimated retail price, $499).
- Microsoft Office Professional and Bookshelf, Microsoft Corp. (Estimated retail price, $599).



- Novell PerfectOffice 3.0 for Windows, Novell ($659).
- Quicken Deluxe 4 for Windows CD-ROM, Intuit Inc. (Estimated street price, $59.95).
- TurboTax Multimedia, Intuit Inc. (Estimated street price, $45).

Magazines on CD-ROM

- Interactive Entertainment, from Interactive Entertainment ($79 per year; 800-562-3624, 802-787-3033).
- Medio Magazine, from Medio Multimedia ($59.95


An interactive movie, Under a Killing Moon has 3-D navigation, video, and a baffling mystery.

Moon, $99.95 from Access Software, is likely to redefine our gaming expectations for years to come. Besides providing a well-conceived story line and lots of gaming time (four CDs in all), this DOS-based mystery offers true 3-D navigation, found previously only in action games, and the sophisticated video sequences we've come to expect from the best adventure games.

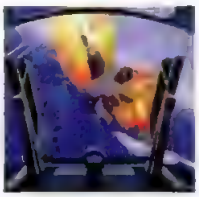
In this game, you are cast as Tex Murphy, a down-and-out private investigator who hasn't had a case in close to a year. Soon, though, all that changes and Murphy is enmeshed in a mystery worthy of the best B-movie film noir classics, except here the story is told with a tongue-in-cheek sensibility and a dash of slapstick humor. The video sequences are better than average and actually help to advance the plot. The acting, too, is better than what we've come to expect from PC games, thanks in large part to the presence of Margot Kidder in the cast and the voice of James Earl Jones.

Heart-pounding action and eye-popping graphics—at resolutions up to 1024-by-768—come together in the DOS-based **U.S. Navy Fighters**, $59.95, a superlative air-combat simulation from Electronic Arts. Best of all, you don't have to be a flight-simulation expert to play. You pilot your way through a detailed and fairly believable plot in one of several types of aircraft. Each mission, after a brief video sequence, is filled with high-flying action. The excellent graphics and sound greatly heighten the sense of realism. Parents should be wary of the radio chatter during flights: There's a fair amount of profanity involved, so you might want to keep this one out of the hands of younger kids.

In **Warren Miller's Ski World**, $49.95 from Multicom Publishing, a handsome Windows interface comes to life in the form of instructional videos, historical overviews, trivia games, skiing records, and a resort database. Warren Miller, the well-known skiing expert, has compiled an intriguing combination of material. The instructional videos cover beginning, intermediate, and advanced levels; skiers demonstrate how to turn, cope with ice and powdery snow, and negotiate extra-bumpy slopes.

In the resort database (licensed from American and European resource books), the world's top resorts are rated according to the challenge they provide, their size and accessibility, and snow quality and production. Finally, 25 video clips show illustrious skiers exhibiting their best moves; you can combine several of them to assemble your own video.

Four CDs and a $4 million dollar budget can barely contain the explosive action and intense cinematics that Origin Systems' **Wing Commander III**, estimated street price $55 to $70, brings to the table. This megagame (DOS-based) catapults you into the final campaign of the 40-year war between the Terran Confederation (that's you) and the Kilrathi (the bad guys)—the outcome is in your hands. You'll fly dozens of tension-filled missions in a nonlinear path toward the climactic battle over one of the two home worlds, Earth or Kilrah. Amazingly, the breathtaking SVGA space-combat action is largely overshadowed by the game's star-studded, full-motion video sequences. As the main character (portrayed by Star Wars' Mark Hamill), you help determine the flow of the game by interacting with a host of Hollywood heavyweights.


U.S. Navy Fighters gives you modern air combat.

First released for the Macintosh platform in 1994, **Xplora 1 Peter Gabriel's Secret World**, $59.95 from Interplay Productions, remains one of the most creative, beautiful, and forward-thinking implementations of multimedia that we have encountered. The Windows-based CD incorporates all the elements a fan could want: selections from Gabriel's music (including full-length videos for four songs "Us", Gabriel's most recent audio release), lyrics, discographies, footage from interviews with Gabriel and his assorted collaborators, footage from Gabriel's studio and his performances, glimpses into the artistic and political causes Gabriel supports, and more.

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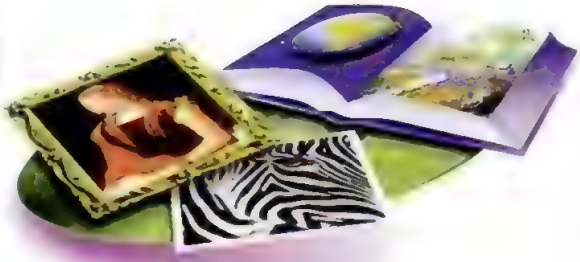
per year, $9.95 per issue; 800-788-3866).

- NautilusCD, from Metatec Corp. ($6.95per month; 800-637-3472).
- PC Magazine CD, from Ziff-Davis Publishing (single copy, $17.95; a one year subscription that includes four multimedia issues, $49.95; 800-787-9677).

Open Letter to CD-ROM Developers

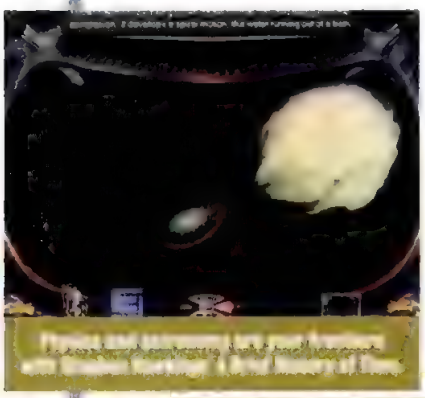
1. Don't automatically install Video for Windows or anything like that without asking us first; you might bring us back to an older version. And do ask about overwriting DLLs/VBXs/EXEs. Show us what's there, show us what



For the
COFFEE TABLE

Lazily skimming through large picture books while sipping espresso at your mahogany coffee table is one of life's great pleasures. These CD-ROMs actually work best when placed in your PC, but a cup of coffee would still go quite nicely with any of them.

Creative Labs' **A Brief History of Time,** $49.95, features an interface full of hot spots and winding paths, all tailored to lead the viewer through the material presented in British scientist Stephen W. Hawking's best selling book of the same title. You can navigate by scrolling through the complete text of the book or by clicking on various areas in a graphical environment. The publishers of this Windows and Macintosh hybrid have thrown in some pretty neat stuff—including Hawking's own narration (remember, he talks through a computer!) and his own explanation of his career and illness.



American Visions, $39.95 from Creative Labs, takes advantage of the CD-ROM medium to let you view the Roy R. Neuberger collection of twentieth century American art. This attractive Windows-based CD features images of the pieces in the collection, scanned in beautifully (the colors are exceptionally vivid) and augmented with quotes by and about the artists, video and photographs of the artists, video commentary from the collector, and historical information to help create a sense of each work's context. You can see all these elements in their minimized form represented by icons on the screen and organized chronologically, thematically, and alphabetically by artist. What's more central to the CD, however, is the linking system. Once an element is displayed at full size, you can click a button to see its links in the form of icons of related elements.

You say it will be a cold day in hell before you take an interest in Antarctica? Cambrix Publishing's **Antarctica**, estimated street price $29, chips away at your icy heart as it shows you that the loneliest, most hostile place on earth is also the last pristine place on earth—and possibly the most beautiful. This Windows-based CD-ROM fascinates with a description of life where nights are four months long and the average winter temperature is -76°.

Antarctica teaches you about the icily beautiful climate.

Want to see a digital presentation about one of the most important archeological finds of the twentieth century?Get **The Dead Sea Scrolls Revealed**, $59.95, a Windows/Macintosh CD from Logos Research Systems.

You can explore different aspects of the history of the scrolls by clicking on a number of frieze-like screen insets. You're then inundated with interesting video clips, detailed pictures, and engaging sounds that make you feel like you're watching a movie rather than using a computer. The CD contains 70 minutes of video clips and 3-D animation letting you zoom in and examine the scrolls, 2 hours of video interviews and historical footage on people and places, and 200 pages of research on the find. The CD provides English translations of some of the major scrolls.

Through the magic of the digital medium, Attica Cybernetics's Windows-based **Great Artists,** $59, offers an intriguing look at the lives and works of 40 major European artists. Based on the collection of London's National Gallery, the CD presents one painting from each artist, addressing such aspects as

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you want to do, and let us decide.

2. Do package your CD-ROMs in jewel boxes or paper equivalent with appropriate labeling on all sides. We already have one of those fancy CD-ROM organizers that stores 200 CD-ROMS, but it needs them in plastic jewel boxes. And don't tell us to add our own jewel boxes, because then we have to label the outside or end up looking at a bunch of clear plastic cases. Also, why not take a tip from the music industry and limit the size of those large CD-ROM boxes (which typically contain one jewel case and a very thin instruction book)? You can condense the manual to the size of liner notes and include it inside the jewel case.

3. Do reorganize, consolidate, push, pull, tuck—whatever is necessary to keep nearly everything on the CD, not on our hard disks. We're tired of shuffling disk space.

In Material World: A Global Family Portrait, visit families all over the world and take a look at their worldly goods.

color, brush technique, and composition. Key vocabulary words are highlighted, so you can instantly access definitions for terms such as brushwork, Renaissance, and abstract.

You search images by painting, artist, or theme (such as love or death) by using the time-line screen, key-word search, or icon bar. The Trail, or log, details what you've seen and where you've wandered, letting you save and retrieve the list and jump back to previously viewed sections.

StarPress Multimedia's **Material World: A Global Family Portrait,** estimated street price $40, could conceivably be the ultimate coffee-table book on CD-ROM. What makes this one unique is the theme of the project: Sixteen photojournalists traveled to thirty nations to live for a week with a family and then photograph them at work, at play, and ultimately, in front of their homes with all their possessions. Combine these poignant photos with video clips, native music, country information, narration from renowned world traveler and TV personality Charles Kuralt, and a database of statistics, and you get a fairly good look at what life is like for people around the world. The CD is a Windows/Macintosh hybrid.

Considered somewhat cheeky in its first decade, People Weekly magazine now looks tame compared with competing electronic and print tabloids like the National Enquirer and television's Hard Copy. So it comes as no surprise that The Voyager Company's **People Weekly: 20 Amazing Years of Pop Culture**, $29.95, focuses less on the trials and tribulations of the stars and regular individuals they've covered since 1974 than the small group of photographers and editors who've worked on the Time-Life publication for the past two decades. Yes, you can see every cover since Mia Farrow graced the periodical in 1974, and there are some entertaining curiosities, such as the Star Map that shows how dozens of luminaries interconnect through various relationships over the last 20 years. And you can see all the best- and worst-dressed covers.

Medio Multimedia's Windows-based **Safari**, developed in conjunction with Alpenglow and narrated by wildlife photographer and author Jonathan Scott, is as close to the Masai Mara National Reserve in Kenya as you're ever going to get for $59.95. And you'll definitely see more than enough to make the trip worthwhile. There are also photos from the Serengeti National Park in Tanzania. This CD is jam-packed with layer upon layer of information, entertainment, music (by D'Cückoo), and action, all highlighted by hundreds of Scott's absolutely stunning wildlife photographs.

Your introduction is a slide show backed by narrative, and then you're off on a series of adventures. The main menu listings let you choose Overview, On Safari (click on a variety of destinations on a clearly drawn map and you are instantly transported to that locale), Guided Tours, Field Guide (see and learn about flora and fauna from A to Z), Viewing Gallery, and Wildlife Photography (handy tips from the master).

Cambrix Publishing's **Small Blue Planet: The Cities Below**, $29, and **Small Blue Planet: The Real Picture World Atlas, Version 2.0**, $39, stand out for their strong visual appeal. The first features aerial views of the biggest cities in the United States. The Real Picture World Atlas features satellite photos and aerial views of cities and geographical wonders

4. Don't insist on working only with 256-color video drivers, not after we've invested in a graphics accelerator that we run in 16-bit mode. Then we have to change video modes and restart Windows just for your CD.
5. Do include some way for us to save our place before we exit, so we can start up again later with the same screen and navigational history.
6. Don't insist on having the CD-ROM drive in the path to run programs from the CD. Your CD isn't always the one in there, and we hate the "Invalid drive in path" errors that pop up when we reboot.
7. Don't forget to include a sound muzzle. We don't have time to explain to our boss why. . . .
8. Do support standard functions. For example, for noise control call the sound-board manufacturer's control panel instead of your own.
9. Do be consistent when offering hot keys. For example, support Alt-Tab as you would with any Windows application.
10. For those who don't bother to do 1 through 9, do include an accurate uninstall feature.

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GET STACKED.™

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all over the globe. The titles work on Windows and Macintosh systems.

The excellent USGS National High Altitude Photography found in the maps of The Cities Below provides interesting views of the nations' sprawling metropolises. For a given city, you might find five or six shots of adjacent areas, and you can view these shots together or individually. You can drill down to access the histories of these places, which begin with backgrounds on native peoples. You can use the Looking Glass tool to view the street maps under the aerial photos, and, from the Expert Panel, add icons with notes to any spot on the map. The Gallery view lets you flip through and select the shots of the cities.

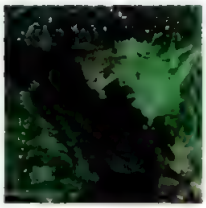
The images in The Real Picture World Atlas, culled from a great number of sources, such as MSS (Multispectral Scanners) and NASA SSEOP (Space Shuttle Earth Observation Photos), let you zoom in on Golan Heights, hover over Chernobyl, or haunt the skyscrapers of Manhattan. The lovely interface features spinning 3-D globes that take you to different sections of the package. A linguistics section provides 15 common phrases spoken and written in over 70 of the world's languages.

World Vista Atlas is not just another map; it's your passport to exploring far-away lands.

The Ultimate Frank Lloyd Wright, $59.95, is for a different audience than the Oxford collection highlighted in our Reference Shelf section. Byron Preiss Multimedia Company's Windows-based CD, which was codeveloped by Microsoft Corp., attempts to create a complete portrait of the master architect by assembling historical material, photographs, video, sound, and text. The developers did a great job of putting together an attractive interface, and there's an active cursor that lets you know where a click will take you. The Walking Tours section of the disk lets you wander through 3-D representations of three Wright masterpieces. A design section, Modeling Wright, lets you assemble your own Wright-style constructions.

It's hard to imagine that a book that delves into the minutiae of physics, electrical activity, and other scientific principles could be considered warm and fuzzy. But David Macaulay's liberal use of woolly mammoths in his book, **The Way Things Work** (published by Houghton Mifflin), and in DK Multimedia's Windows-based CD version of the same, $49.95, makes the subject matter into something anyone could cozy up to. This well-illustrated and whimsically animated CD manages to be technical but never dull. The opening Workshop screen leads you to sections on Machines, Principles of Science, History Inventors, and so on. Animations of both the principles at work and a few extra bits of whimsy are included (like an animation that illustrates how woolly mammoths could be used to fight fires). Every subject is hyperlinked to other related topics, and navigating through the Windows-based CD is an entertaining breeze.

The Way Things Work's opening screen is full of animation, sound, and surprises.


Small Blue Planet: The Real Picture World Atlas

The Windows-based **World Vista Atlas**, $49.95 from Applied Optical Media Corp., truly takes advantage of its multimedia format. The cartography content is culled from Rand McNally's detailed and up-to-date maps of 236 countries. The standard map information is supplemented with facts and statistics from Rand McNally, high-quality photographs, historical and political background, informative animations, and language and music samples (the music samples are from the Smithsonian's Folkways Collection). It's all presented in intuitive fashion, tied together with strong cross-referencing and a variety of links. □

Our Contributors TIN ALBANO, RICK AYRE, JEANNE ALBRECHT, MARY BEHR, MARIAN BERELOWITZ, GLEN BOISSEAU BECKER, ERYN BROWN, JAMIE BSALES, KATHLEEN CASTER, LAURA COX, JOHN DELANEY, GAYLE EHRENMAN, CURTIS FIELDS, JIM GALLEY, BEN GOTTESMAN, ELIZABETH HOLZER, TOM MACE, CADE METZ, MICHAEL MUCHMORE, JAY MUNRO, KATHRYN FRAME MUNRO, JACKIE PAREDES, MELISSA PERENSON, MARGARET PIEMONTE, KEN PRAKOBCHART, ROBIN RASKIN, TRACY REPPERT, SAL RICCIARDI, PAUL ROSS, MIKE RYAN, GREG SEWELL, DEVAL SHAH, AMARENDRA SINGH, ASA SOMERS, DAN SMITH, JODI WYNBLATT, ANUSH YEGYAZARIAN, and LANCE ULANOFF, who was the Associate Editor in charge of this story.

THE TOP 100 LIST

FOR THE OFFICE

Cambium Sound Choice, Volume 2, Cambium Development Inc. 800-231-1779. List price, $69. *Circle 535 on reader service card*

Corel Gallery 2, Corel Corp. 800-772-6735 (USA), 800-394-3729 (Canada), 613-728-8200. List price, $99. *Circle 536 on reader service card*

Corel Stock Photo Library, Corel Corp. 800-772-6735 (USA), 800-394-3729 (Canada), 613-728-8200. List price, $995. *Circle 536 on reader service card*

HP Support Assistant, Hewlett-Packard Co. 800-457-1762. List price, $395 per year. *Circle 448 on reader service card*

Microsoft Developer's Network CD, Microsoft Corp. 800-759-5474, 303-684-0914. List price, $195 (Level I), $495 (Level II). *Circle 471 on reader service card*

Microsoft TechNet, Microsoft Corp. 800-426-9400, 206-882-8080. List price, $299 (single-user license), $699 (unlimited user license); updated CD released monthly. *Circle 471 on reader service card*

Multimedia Business 500, Release 2, Allegro New Media. 800-424-1992, 201-808-1992. List price, $49.95. *Circle 541 on reader service card*

Multimedia MBA Small Business Edition, SoftKey International. 800-227-5609, 617-494-1200. List price, $149.95. *Circle 542 on reader service card*

Multimedia Typing Instructor, Individual Software Inc. 800-822-3522, 510-734-6767. Estimated street price, $29. *Circle 543 on reader service card*

PhoneDisc PowerFinder '95, Digital Directory Assistance Inc. 800-284-8353, 617-639-2900. List price, $249. *Circle 544 on reader service card*

PhotoDisc Signature Series, PhotoDisc Inc. 800-528-3472, 206-441-9355. Estimated street price, $299 per CD. *Circle 545 on reader service card*

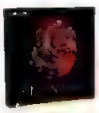
Select Phone, Pro CD Inc. 800-992-3766, 508-750-0000. List price, $299. *Circle 546 on reader service card*

FOR THE REFERENCE SHELF

A.D.A.M. The Inside Story, A.D.A.M. Software Inc. 800-408-2326, 619-549-0222. Estimated street price, $39. *Circle 547 on reader service card*

American Heritage Talking Dictionary, SoftKey International. 800-227-5609, 617-494-1200. List price, $59.95. *Circle 542 on reader service card*

Beethoven and Beyond, The Voyager Company. 800-446-2001, 914-591-5500. List price, $24.95. *Circle 499 on reader service card*



Berlitz Live! Spanish, Sierra On-Line. 800-757-7707, 206-649-9800. Estimated street price, $110. *Circle 550 on reader service card*

Beyond the Sambatyon: The Myth of the Ten Lost Tribes, Creative Multimedia. 800-262-7668, 503-241-4351. Estimated street price, $30. *Circle 486 on reader service card*

The Complete Multimedia Bible, Compton's NewMedia. 800-862-2206, 619-929-2500. List price , $49.95. *Circle 473 on reader service card*

Compton's Interactive Encyclopedia, 1995 Edition, Compton's NewMedia. 800-862-2206, 619-929-2500. Estimated street price, $70 to $90. *Circle 473 on reader service card*

Frank Lloyd Wright: Presentation and Conceptual Drawings, Oxford University Press. 800-334-4249, 212-726-6000. List price, $1,500. *Circle 487 on reader service card*

Her Heritage, A Biographical Encyclopedia of Famous American Women, Cambrix Publishing. 800-992-8781, 818-992-8484. Estimated street price, $29. *Circle 522 on reader service card*

Lost Treasures of the World with Stan Grist, Follgard CD Visions Inc. 800-721-1142. List price, $49.95. *Circle 489 on reader service card*

Microsoft Encarta '95, Microsoft Corp. 800-426-9400, 206-882-8080. Estimated street price, $100. *Circle 471 on reader service card*

Multimedia Space Explorer, Betacorp. 800-268-2382, 905-564-2424. List price, $39.95. *Circle 490 on reader service card*

The 1995 Grolier Multimedia Encyclopedia, Grolier Electronic Publishing. 800-285-4534, 203-797-3530. Estimated street price, $89. *Circle 493 on reader service card*

PC Globe Maps 'N' Facts, Brøderbund Software Inc. 800-521-6263, 415-382-4400. Estimated street price, $35. *Circle 478 on reader service card*

Power Japanese 2.0, Bayware Inc. 800-538-8867, 415-286-4492. Estimated street price, $165 to $199. *Circle 496 on reader service card*

The Random House Unabridged Electronic Dictionary, Random House Reference and Electronic Publishing, 800-793-2665, 410-848-1900. List price, $79. *Circle 470 on reader service card*

The Rosetta Stone Level Ia Russian and the Rosetta Stone PowerPAC, Fairfield Language Technologies. 800-788-0822, 703-432-6166. List price: Level Ia Russian, $395: PowerPAC, $99. *Circle 498 on reader service card*

3D Atlas, ABC/EA Home Software. 800-245-4525, 415-571-7171. List price, $79.95. *Circle 480 on reader service card*

The 20th Century Video Almanac, Mindscape Inc. 800-234-3088, 415-883-3000. List price, $49.95. *Circle 475 on reader service card*

Vietnam, Medio Multimedia. 800-788-3866, 206-867-5500.

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The Art of Making Great Pastries, Cambrix Publishing. 800-992-8781, 818-992-8484. Estimated street price, $28. *Circle 522 on reader service card*

4 Paws of Crab, Live Oak Multimedia Inc. 800-454-7557, 510-654-7480. List price, $44.95. *Circle 504 on reader service card*

Kittens to Cats, Villa Crespo Software Inc. 800-521-3963, 708-433-0500. List price, $49.95. *Circle 509 on reader service card*

Martial Arts Explorer, FutureVision Multimedia Inc. 800-472-8777, 914-426-0400. List price, $49.95. *Circle 510 on reader service card*

Microsoft Automap Road Atlas 4.0, Microsoft Corp. 800-426-9400, 206-882-8080. Estimated retail price, $39.95. *Circle 471 on reader service card*

Popular Mechanics New Car Buyers Guide, Books That Work/Hearst New Media. 800-242-4546, 415-326-4280. List price, $49.95. *Circle 511 on reader service card*

Rand McNally TripMaker, Rand McNally New Media. 800-671-5006, ext. 108; 708-329-8100. List price, $79.95. *Circle 470 on reader service card*

3D Home Architect CD-ROM, Brøderbund Software Inc. 800-521-6263, 415-382-4400. Estimated street price, $70. *Circle 478 on reader service card*

Total Health—Body and Mind, SoftKey International. 800-227-5609, 617-494-1200. List price, $79.95. *Circle 542 on reader service card*

Understanding Exposure: How to Shoot Great Photographs, DiAMAR Interactive Corp. 800-234-2627, 206-340-5975. List price: with companion book, $79.95; CD-ROM only, $59.95. *Circle 514 on reader service card*

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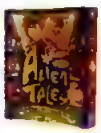
Adventures with OSLO Tools & Gadgets, Science for Kids. 800-572-4362, 910-945-9000. List price, $59.95. *Circle 477 on reader service card*



Alien Tales, Brøderbund Software Inc. 800-521-6263, 415-382-4400. Estimated street price, $45. *Circle 478 on reader service card*

Alistair and the Alien Invasion, Simon and Schuster Interactive. 800-983-5333, 212-698-7000. List price, $49.95. *Circle 479 on reader service card*

Counting on Frank, ABC/EA Home Software. 800-245-4525, 415-571-7171. List price, $49.95. *Circle 480 on reader service card*

Crayola Amazing Art Adventure and Crayola Art Studio, Micrografx Inc. 800-676-3110, 214-994-6405. Estimated street price for each, $40. *Circle 481 on reader service card*

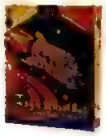
Discovering Endangered Wildlife, Lyriq International Corp. 800-433-4464, 203-250-2070. List price, $39.95. *Circle 482 on reader service card*

Freddi Fish and the Case of the Missing Kelp Seeds, Humongous Entertainment. 206-485-1212. Estimated street price, $40. *Circle 483 on reader service card*

Harry and the Haunted House, Living Books. 800-776-4724. Estimated street price, $40. *Circle 484 on reader service card*

How Things Work in Busytown, Viacom New Media. 800-469-2539, 212-258-6000. Estimated street price, $50. *Circle 485 on reader service card*

Lenny's Multimedia Circus and Lenny's Time Machine, Viacom New Media. 800-469-2539, 212-258-6000. Estimated street price, $50 each. *Circle 485 on reader service card*



Magic School Bus Explores the Solar System, Microsoft Corp. 800-426-9400, 206-882-8080. Estimated street price, $50. *Circle 471 on reader service card*

Memphis Math: Treasure of the Tombs, Novell Inc. 800-451-5151, 801-225-5000. List price, $59. *Circle 488 on reader service card*

Microsoft Dangerous Creatures, Microsoft Corp. 800-426-9400, 206-882-8080. Estimated retail price, $60. *Circle 471 on reader service card*

Microsoft Explorapedia: World of Nature, Microsoft Corp. 800-426-9400, 206-882-8080. Estimated retail price, $35. *Circle 471 on reader service card*

My First Encyclopedia, Knowledge Adventure Inc. 800-542-4240, 818-542-4000. Estimated street price, $35 to $45. *Circle 491 on reader service card*

My First Incredible, Amazing Dictionary, DK Multimedia. 800-225-3362, 212-213-4800. Estimated street price, $40. *Circle 492 on reader service card*

Nickelodeon Director's Lab, Viacom New Media. 800-469-2539, 212-258-6000. Estimated street price, $60. *Circle 486 on reader service card*

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Science Sleuths, Videodiscovery Inc. 800-548-3472. List price, $59.95. *Circle 495 on reader service card*

Where in the World is Carmen Sandiego?, Junior Detective Edition, Brøderbund Software Inc. 800-521-6263, 415-382-4400. Estimated street price, $40. *Circle 478 on reader service card*

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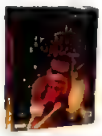
Bob Dylan: Highway 61 Interactive, Graphix Zone Inc. 714-833-3838. List price, $59.95. *Circle 497 on reader service card*

Chuck Jones' Peter and the Wolf, Time Warner Interactive. 800-482-3766, 818-295-6600. List price, $29.95. *Circle 501 on reader service card*



Dark Forces, LucasArts Entertainment Company. 800-782-7927, 415-721-3300. Estimated street price, $55. *Circle 476 on reader service card*

Dazzeloids, The Voyager Company. 800-446-2001, 914-591-5500. List price, $40. *Circle 499 on reader service card*

DOOM II: Hell on Earth, GT Interactive Software/id Software. 800-362-9400. Estimated street price, $39 to $49. *Circle 500 on reader service card*

Flash Traffic City of Angels, Time Warner Interactive. 800-482-3766, 818-295-6600. List price, $29.95. *Circle 501 on reader service card*

Johnny Mnemonic, Sony Imagesoft. 800-922-7669. Estimated street price, $70. *Circle 502 on reader service card*

Microsoft Cinemania '95, Microsoft Corp. 800-426-9400, 206-882-8080. Estimated street price, $60. *Circle 471 on reader service card*

Microsoft Complete NBA Basketball, Microsoft Corp. 800-426-9400, 206-882-8080. Estimated street price, $50. *Circle 471 on reader service card*

Monty Python's Complete Waste of Time, 7th Level Inc. 800-884-8863, 214-437-4858. Estimated street price, $50. *Circle 505 on reader service card*

MTV's Club Dead, Viacom New Media. 800-469-2539, 212-258-6000. Estimated street price, $60. *Circle 485 on reader service card*

NASCAR Racing, Papyrus Design Group Inc. 800-836-1829, 617-868-5440. Estimated street price, $55 to $65. *Circle 507 on reader service card*

NHL Hockey '95, Electronic Arts. 800-245-4525, 415-571-7171, ext. 7555. List price, $59.95. *Circle 508 on reader service card*

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The Residents Freak Show, The Voyager Company. 800-446-2001, 914-591-5500. List price, $49.95. *Circle 499 on reader service card*

SimCity 2000 CD Collection, Maxis. 800-331-2947, 510-254-9700. Estimated street price, $70. *Circle 512 on reader service card*

Sports Illustrated Multimedia Almanac, 1995 Edition, StarPress Multimedia. 800-500-8682, 415-274-8383. Estimated street price, $40. *Circle 513 on reader service card*

Star Trek: The Next Generation Interactive Technical Manual, Simon and Schuster Interactive. 800-983-5333, 212-698-7000. List price, $69.95. *Circle 479 on reader service card*

Transport Tycoon, MicroProse Software. 800-879-7529, 410-771-0440. Estimated street price, $58. *Circle 515 on reader service card*

Under a Killing Moon, Access Software Inc. 800-800-4880, 801-359-2900. List price, $99.95. *Circle 516 on reader service card*

U.S. Navy Fighters, Electronic Arts. 800-245-4525; 415-571-7171, ext. 7555. List price, $59.95. *Circle 508 on reader service card*

Warren Miller's Ski World, Multicom Publishing. 800-850-7272, 206-622-5530. List price, $49.95. *Circle 518 on reader service card*

Wing Commander III, Origin Systems. 800-245-4525, 512-335-5200. Estimated street price, $55 to $70. *Circle 519 on reader service card*

Xplora 1 Peter Gabriel's Secret World, Interplay Productions. 800-969-4263, 714-553-6655. Estimated street price, $60. *Circle 520 on reader service card*

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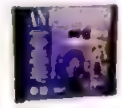
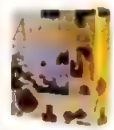
American Visions, Creative Labs Inc. 800-998-5227, 408-428-6600. List price, $39.95. *Circle 521 on reader service card*



Antarctica, Cambrix Publishing. 800-992-8781, 818-992-8484. Estimated street price, $29. *Circle 522 on reader service card*

A Brief History of Time, Creative Labs Inc. 800-998-5227, 408-428-6600. List price, $59.95. *Circle 521 on reader service card*

The Dead Seas Scrolls Revealed, Logos Research Systems. 800-875-6467, 360-679-6575. List price, $59.95. *Circle 524 on reader service card*



Great Artists, Attica Cybernetics. 800-721-2475, 818-882-9184. List price, $59. *Circle 525 on reader service card*

Material World: A Global Family Portrait, StarPress Multimedia. 800-500-8682, 415-274-8383. Estimated street price, $40. *Circle 513 on reader service card*

People Weekly: 20 Amazing Years of Pop Culture, The Voyager Company. 800-446-2001, 914-591-5500. List price, $29.95. *Circle 499 on reader service card*

Safari, Medio Multimedia Inc. 800-788-3866, 206-867-5500. List price , $59.95. *Circle 528 on reader service card*

Small Blue Planet: The Cities Below, and Small Blue Planet: The Real Picture Atlas, Version 2.0, Cambrix Publishing. 800-992-8781, 818-992-8484. Estimated street price, $29 and $39, respectively. *Circle 522 on reader service card*

The Ultimate Frank Lloyd Wright, Byron Preiss Multimedia Company Inc./Microsoft Corp. 212-989-6252. List price , $59.95. *Circle 530 on reader service card*

The Way Things Work, DK Multimedia. 800-225-3362, 212-213-4800. Estimated street price, $50. *Circle 492 on reader service card*

World Vista Atlas, Applied Optical Media Corp. 800-321-7259, 610-429-3701. List price , $49.95. *Circle 532 on reader service card*

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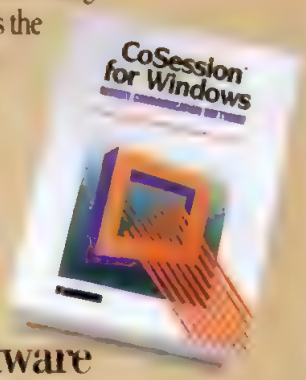

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By Padraic R. Boyle

Today's servers are high-performance pieces of equipment that are crucial to your business. Moreover, these servers are in the hot seat every day and need to be not only fast but also fault-tolerant, expandable, and manageable.

How much performance, fault tolerance, expandability, and manageability you'll require depends upon your environment. A small group of a dozen or so workstations requires a totally different class of server than one handling a hundred users in a department connected to a corporate backbone. We reviewed that first class of machine, the *workgroup server,* in our issue of March 26, 1995; here we focus on the more powerful and robust *departmental server.*

A departmental server differs from a workgroup server in numerous ways. It has more mass-storage capacity and more network interface cards (NICs), plus more ex-

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Products reviewed:

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Photography by Scott Peterson

pandability and scalability. Of course, it costs more, too: prices range from $10,000 to $20,000, depending on configuration.

We elected to focus here strictly on *file servers*—centralized repositories for data, heavily dependent on I/O—as opposed to *application servers*, used primarily in client/server environments to run CPU-intensive programs. The dominant PC platform for file service is Novell's NetWare, so we acquired and tested 14 file servers running NetWare 3.12. Our testbed comprised up to 60 workstations (386- and 486-class machines), which could represent anywhere from a couple of dozen extraordinarily busy users to a few hundred light network users.

REVIEW CRITERIA

We asked vendors to ship us their departmental file servers equipped with 128MB of RAM, approximately 4GB of disk space, and four Ethernet adapters (or one quad Ethernet adapter capable of supporting four network segments). We left the choice of CPU largely up to vendors, requiring at least a 486DX2/66 or faster. We also required a CD-ROM drive to simplify the loading of software, and a basic-VGA display subsystem.

We had the vendors install a copy of NetWare 3.12, with a 100-user license. The price of NetWare (about $4,000) is not included in the overall prices quoted for these systems since many vendors rely on their resellers to install NetWare for end users. We also asked vendors to install their preferred server management package. We allowed each vendor to tune the server's NetWare settings to its preferences.

RECENT REVIEWS

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▶ **Born to Serve**
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7 workgroup servers.

▶ **File Servers: Data on Demand**
October 11, 1994.....*page 187*
15 departmental file servers.

Although we did not require vendors to include a tape-backup solution or an uninterruptible power supply (UPS), both are a must for any server you deploy in your organization. The most appropriate tape-backup solution for servers in this class is a 4-mm DAT (digital audio tape) drive. The UPS you choose should have a minimum 450-volt-ampere capacity.

After we concluded testing for this story, Austin Computer (800-483-9938) sent us its new Affinity XE Pentium-based server. As a result, we were not able to review it here; however, our early test runs on the Affinity XE demonstrated that it was an above-average performer.

What does the $10,000 to $20,000 price of the servers in this roundup buy you? A comparable Pentium desktop PC with 128MB of RAM and 4GB of disk space would cost close to $9,000. Most of the difference lies in the EISA/PCI bus, superior expandability, fast disk-subsystem technology, large amounts of memory and symmetrical processing capabilities, more thorough documentation, server management capabilities, and enhanced support services.

PERFORMANCE

Though performance isn't the only thing you should look for in a departmental server, it's an important basic consideration. We used our NetBench, Version 3.0, Disk Mix tests to collect data on both the throughput and CPU utilization of these servers. *Throughput* is the rate at which data is passed between the server and all the workstations on the network; *CPU utilization* is the amount of the CPU's processing power that is consumed in the process. (CPU utilization thus provides a measure of *headroom*—how much additional processing power is available to service further network requests; lower num-

HIGHLIGHTS

Departmental File Servers

Departmental file servers—handling anywhere from a few dozen to a few hundred workstations—are reaching new levels of sophistication. What began as a desktop PC flipped on its side is now a unit engineered for maximum performance, expandability, security, fault tolerance, and manageability. We tested 14 models priced from $9,556 to $22,880.

PERFORMANCE IS BETTER than ever: so good, in fact, that the physical Ethernet connection becomes a limiting factor before the best servers' component hardware runs out of steam. Proper tuning is critical; by setting NetWare parameters appropriately, you can nearly double performance of the same base hardware.

PCI IS THE BUS of choice in these servers. EISA is still present for compatibility, but PCI offers better performance—both in theory and in practice. Bridged PCI buses, found in the Digital Equipment Corp. and Hewlett-Packard Co. machines, overcome PCI's typical limit of three or four expansion cards by making a secondary PCI bus a slave to the primary PCI bus. Later this year you'll see dual-PCI-bus designs, in which two peer PCI buses are connected to the CPU.

FAST/WIDE SCSI-2 disk subsystems make their first broad appearance, but implementation is often incomplete. Many vendors pair Fast (but Narrow) controllers with Fast/Wide disks, removing the throughput advantage that a complete Fast/Wide design allows.

BEFORE YOU BUY, remember to outfit your server with fail-safe peripherals. A tape-backup system is a must, as is an uninterruptible power supply. Also worth considering: a RAID (redundant array of inexpensive disks) subsystem that can rebuild data even if one disk fails.

bers indicate more untapped processing power.)

Although there was a sizable difference in performance among most of the machines, the systems at the high end appeared to be almost *wirebound;* that is, they nearly hit the ceiling imposed by the 10-megabit-per-second signaling speed of each of the four Ethernet segments we used with capacity to spare.

We allowed each vendor to tune its server for its best performance, and tested each system as it came out of the box. After completing those tests, we configured each system with a set of parameters that experience has taught us is optimal for NetBench. We observed a dramatic improvement in most of the servers' throughput, demonstrating that although the underlying hardware may be capable, tuning for your particular applications' needs is critical to maximizing performance.

Of course, there are plenty of ways to tune the hardware itself too. One of the best known is to use multiple hard disks, or *spindles*. By spreading or striping the data, the read/write head's movement is reduced and therefore speeds throughput. And throwing memory at a problem can't hurt either. NetWare loves memory; it caches the network directory structures, the most recently accessed files, and NLMs (NetWare Loadable Modules) in memory. The more you've got, the less often you'll hit the physical disks.

WHAT'S INSIDE

All 14 of the reviewed systems came with 90- or 100-MHz Intel Pentium processors. With the exception of the DFI Diamond P100 Server, the Hertz P100e, and the IBM PC Server 500, all of the systems support an optional second CPU. Since NetWare currently only supports a single processor, though, buying multiprocessor support is really buying for the future.

All but one of the systems had a dual-bus architecture—either ISA/PCI, EISA/VL-Bus, or EISA/PCI. The exception was the PC Server 500, which had a Micro Channel architecture. The ISA/PCI combination, found in the Diamond P100, Hertz P100e, and the Polywell Poly 500D2, is more typical of a desktop PC. In a server environment, where speedy I/O is a must, PCI provides the best solution because it transfers data at faster rates than both EISA and ISA.

The only bus that comes close to PCI, as far as rated throughput is concerned, is VL-Bus—a 32-bit, typically 33-MHz local bus with 133-megabyte-per-second (MBps) maximum throughput. But most system and expansion-card vendors are concentrating their efforts on PCI; the Unisys SME 510010 was the only server in the roundup to support an EISA/VL-Bus architecture.

Though many of the servers here had only three PCI slots, Digital's Prioris HX 590 Server boasted two bridged PCI buses to offer a total of six PCI slots. Hewlett-Packard Co.'s NetServer LH had a similar design but embedded two Fast SCSI-2 adapters onto the system's motherboard, slightly reducing the number of supported PCI devices and leaving five PCI slots.

Vendors chose a variety of Ethernet adapters. DFI, GAIN Systems, Hertz Computer Corp., HP, National Micro-Computers, Polywell Computers, and Tangent Computer all used quad Ethernet

• Digital Prioris HX 590 Server
• HP NetServer LH

What goes into the perfect departmental file server? Just take a look at Digital's $17,900 Prioris HX 590 Server. The Prioris HX is more than a stellar performer. It offers impressive expandability: eleven drive bays, six EISA slots and six PCI slots (thanks to a bridged design that chains together two PCI buses). It provides hot-swappable hard disks and an optional redundant power supply. Even its server management features are first-class; they include a hardware controller card that connects to a remote workstation and comes with its own power supply and real-time clock to provide access to an errant server.

The $14,450 HP NetServer LH is another outstanding product. The NetServer LH matches the Prioris HX in almost every regard: top-tier performance and superb server management features, plus one of the most impressive designs we've ever seen. The NetServer LH also employs a bridged PCI design and it incorporates a pair of Fast SCSI-2 controllers right onto the motherboard to allow for low-cost disk-duplexing capability. Our only minor complaint: The built-in controllers can't support the Fast/Wide SCSI-2 mode that the hard disks are capable of supporting. To its credit, the NetServer LH offers one of the simplest setups imaginable.

HONORABLE MENTIONS

Right on the heels of the Prioris HX and the NetServer LH are two machines that we've awarded honorable mentions: the $17,848 Compaq ProLiant 1500 and the $22,880 IBM PC Server 500. The ProLiant 1500 is an evolutionary improvement on the Compaq ProLiant 1000 486DX2/66 that won an Editors' Choice in our last roundup of departmental file servers; it adds PCI slots and a new version of Compaq Insight Manager, one of our favorite server management packages. On our performance tests, the ProLiant 1500 placed among the best units here.

The PC Server 500 is likewise a first-rate performer. Its one significant liability is its reliance on IBM's Micro Channel architecture (MCA). Though technically impressive, MCA is quickly losing ground to PCI. As faster networking standards such as 100Base-T take hold, a PCI/EISA combination will offer far greater flexibility and choice of adapter cards. The PC Server 500 is also the most expensive unit here.

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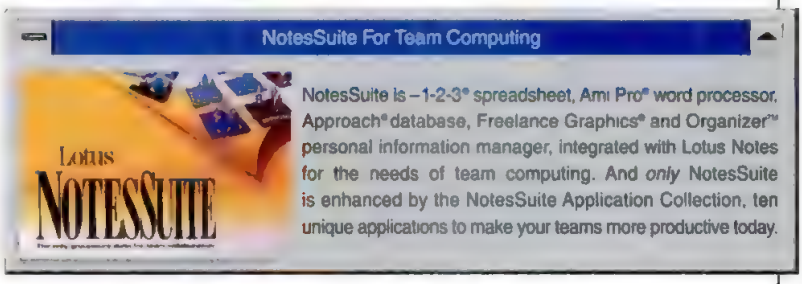

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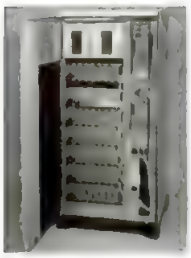

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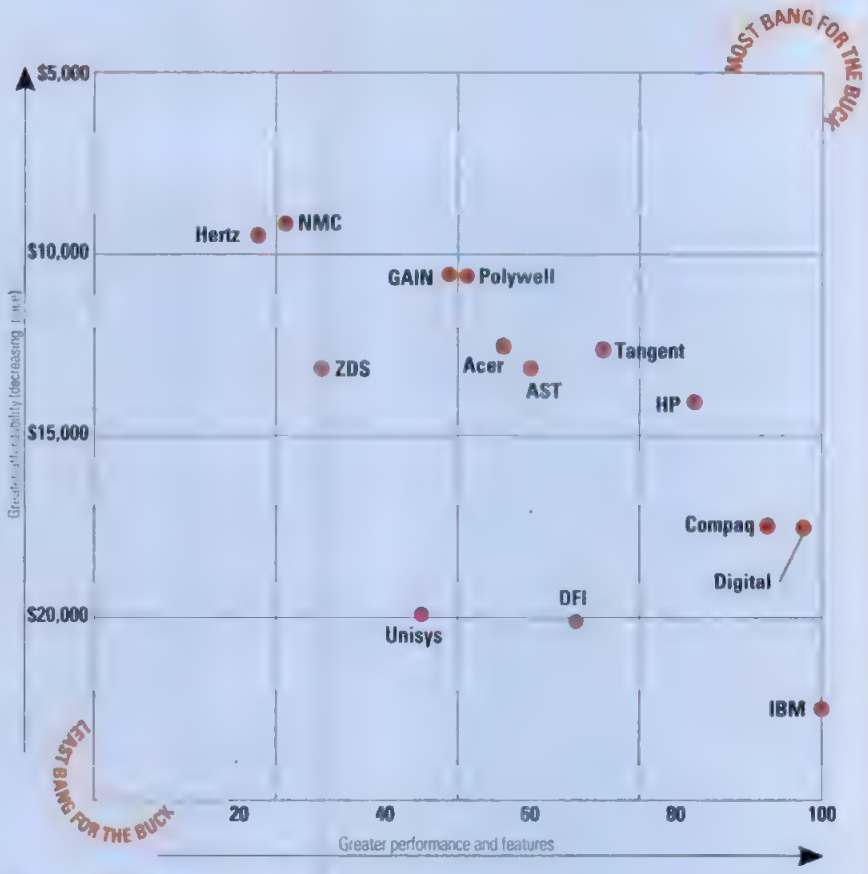
Price/Performance Index: *Departmental File Servers*

The Tangent Just'N'Case SMP 100 occupies the most favorable spot on our chart, thanks to its low $12,990 price. But we think that the better overall bargains are our Editors' Choices, the Digital Prioris HX 590 Server and the HP NetServer LH, which are priced somewhat higher but also provide far more complete solutions. The $15,000 Prioris HX offers top-flight performance coupled with impressive expandability: 11 drive bays, six EISA slots, a bridged PCI design with six PCI slots, hot-swappable hard disks, and a cutout for an additional power supply.

Like the Digital system, the $14,450 NetServer LH takes advantage of PCI bridging. To maximize expandability, HP integrates two SCSI controllers right onto the motherboard, so it supports disk duplexing (for superior fault tolerance) right out of the box.

Two units that earned honorable mentions—the Compaq ProLiant 1500 and the IBM PC Server 500—also placed solidly on our chart. Compaq's $17,848 ProLiant 1500 offers top-tier performance and Insight Manager, its excellent server management package. The $22,880 IBM PC Server 500 received the highest performance/features score but is priced higher than any other machine.—*Analysis written by Mary E. Behr*



THE DATA POINTS

Test scores count for 40 percent of the performance/features score; management, documentation, and warranty each contribute 10 percent. Expandability and fault tolerance make up the remainder of the score. For more information, look in the Hardware Library of the Editorial Forum on PC MagNet under 12BNG95.TXT.

PCI adapters. These adapters combine four separate Ethernet chip sets with a PCI bus in one adapter. The card's PCI-to-PCI bridge makes its PCI bus a slave, in essence, to the PCI bus whose slot is used by the card.

Acer America, Unisys Corp., and Zenith Data Systems all opted for an EISA-based NIC—and paid the price in performance. Compaq (which uses a proprietary core-logic chip set) supplied its NetFlex-2 EISA adapters and Digital included its own EtherWorks PCI Turbo DE435 adapters; both are single-port adapters. AST's Manhattan V 5090 used two EISA adapters and two PCI adapters.

SCSI: WIDER IS BETTER

Of the multitude of SCSI flavors available today, the two you're likely to see in servers are *Fast SCSI-2* and *Fast/Wide SCSI-2*. The first, sometimes referred to as Fast/Narrow (in contrast to Fast/Wide), provides an 8-bit data path and transfer rates of up to 10 MBps. Fast/Wide SCSI supports a 16-bit data path, doubling the maximum throughput to 20 MBps. As our test results demonstrate, the servers that employed a Fast/Wide drive configuration all the way through—from the disks to the controller—performed the best.

DFI, Digital, GAIN, Hertz, IBM, and National MicroComputers all shipped Fast/Wide drives and Fast/Wide adapters in their servers. Acer, Compaq, and Polywell provide support for Fast/Wide technology on their disk controllers; however, they shipped their systems with Fast/Narrow drives.

Conversely, the NetServer LH

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Suitability to Task: Departmental File Servers

The **performance** rating is a measure of how well a server performed on our NetBench tests across a variety of client loads. Servers rated *excellent* marry high throughput with low CPU utilization, providing plenty of performance with room for future growth.

The **security/fault-tolerance** rating indicates to what extent a server provides redundant components and implements basic security features. Some of the major factors figuring into this rating include the presence of multiple power supplies, duplexed disk controllers, error-correcting memory, hot-swappable hard disks, temperature sensors, BIOS-based password protection, and case key locks. Systems rated *excellent* deliver strong insurance against casual tampering or corrupted data.

The **expandability/scalability** rating reflects a server's ability to be upgraded. Principal considerations include the number of drive bays, maximum RAM support, power-supply wattage and the number and type of expansion slots (with an emphasis on EISA and PCI slots). Units rated *excellent* offer spacious cases and plenty of open expansion slots.

The **server management** rating reflects the features a server provides to assist the network manager in keeping the server running optimally. We consider the quality of documentation and warranty terms (including on-site service). Other factors include remote-notification and remote management features, advanced diagnostics, and tools to track memory- and disk-subsystem faults. Servers rated *excellent* provide detailed documentation, comprehensive warranty coverage, and a variety of software server- management tools.

SUITABILITY TO TASK

Product Name	
Performance	Poor
Security/ Fault tolerance	Fair
Expandability/ Scalability	Good
Server management	Excellent

shipped with Fast/Wide drives installed, but the embedded disk adapters only supported Fast/Narrow technology. Because the NetServer LH's drive chassis can accommodate either Fast/Wide or Fast/Narrow drives, it is left up to the embedded SCSI-2 adapters to autosense the drives and funnel the data into the Fast/Narrow channel. HP does offer an upgrade to a controller that supports Fast/Wide mode.

AST Research and Zenith Data Systems integrated Fast/Narrow adapters on their systems' motherboards, but the ZDS machine can still be upgraded to support a Fast/Wide configuration. Tangent shipped its unit with an Adaptec AHA-2940 disk controller, while the Unisys offering came with a Mylex DAC960E adapter. These Fast/Narrow adapters can be easily upgraded to the Adaptec AHA-2940W or Mylex DAC960P, respectively, to support Fast/Wide drives.

FAULT TOLERANCE

Hot-swappable hard disks—which allow you to remove and replace a failed disk without shutting down the server—are probably the most substantial fault-tolerance feature available. Of the servers reviewed, only those from Digital and IBM supported hot-swappable disk subsystems right out of the box. Many can be upgraded with more sophisticated controllers that support hot-swapping.

RAID (Redundant Array of Inexpensive Disks) technology can improve performance as well as data security in any server environment. For example, in a RAID 5 configuration, data is striped across multiple disks. The hard disk controller employs an error-checking and correcting (ECC) technique that sends an alert in the event that a drive has failed; once a replacement disk is inserted, data can be reconstructed automatically.

Another fault-tolerance measure is *duplexing*—mirroring two sets of disks *and* two adapters. The NetServer LH was designed to accommodate duplexing internally without any additional hardware. With two independent Fast SCSI-2 adapters embedded on the motherboard and two separate drive cages that can accommodate three disks each, one set of disks can be configured to mirror the other.

To prevent data from being damaged by random memory errors, server vendors are increasingly turning to ECC memory, which can detect *and* correct random single-bit errors in memory. Standard parity memory can merely detect errors and halt the server. The Compaq, Digital, HP, IBM, and Unisys systems ship standard with ECC memory installed (although the early production HP unit we tested did *not* have ECC memory); AST, GAIN, and Hertz offer ECC memory as an option.

MANAGING THE SYSTEM

For an additional $400 to $2,000 or more, most vendors will supply their own or a third-party management package to monitor server functions either locally or remotely. Both Digital and Compaq offer proprietary solutions that monitor overall system status, voltage, and temperature. Digital's unit included a modem, enabling it to send remote notification via modem or pager in the event of a failure.

Some also offer quick-start utilities on CD-ROMs, such as Compaq's SmartStart, IBM's ServerGuide, and Hewlett-Packard's NetServer Navigator. While both SmartStart and ServerGuide will walk you through the installation of a network operating system (NOS), Navigator will configure the EISA and PCI adapters and create a disk with the appropriate drivers needed during a NOS installation.

The 14 reviews that follow detail how each server stacks up.

Acer America Corp.

AcerAltos 7000/p

With the AcerAltos 7000/p, Acer America has brought an already well-built server line up to speed. The AcerAltos 7000/p now offers PCI support as well as a proprietary server management package that adds some of the fault-tolerance and remote management features that were lacking in the previous version of this system (reviewed in "File Servers: Data on Demand," October 17, 1994). The $15,500 price tag is also lower than that of many systems in this roundup.

SUITABILITY TO TASK

AcerAltos 7000/p	
Performance	Fair
Security/ Fault tolerance	Fair
Expandability/ Scalability	Good
Server management	Fair

Acer also offers the entry-level AcerAltos 800/p, designed primarily to be a file server for a small network or for use as a workgroup server. At the high end of Acer's server line is the AcerAltos 17000, which supports from one to four processors and is geared to be an enterprise server.

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The inclusion of a server management package is the most innovative feature of the AcerAltos 7000/p and it shows Acer's interest in providing a complete server solution beyond a box full of hardware. Acer Server Manager is a SCO Unix–based package that offers the administrator a number of useful management tools including monitoring of CPU activity as well as local notification and remote notification via a pager, fax, or SNMP. The package also will allow the administrator to manage a number of remote sites with basic administration tools.

The AcerAltos 7000/p's design is still the same, with 12 drive bays (8 of them support removable drives) offering adequate expandability. The hard disks plug into a backplane card that runs a cable to the motherboard's integrated SCSI controller. This design neatly arranges all cabling to and from the motherboard, disk drives, and power supply, eliminating some of the headaches for the network administrator. Each of the hard disks is individually secured via a switch on each drive tray but these switches are not protected, so if the front door is open the drives can still be easily removed. Though the case is designed to allow disk hot-swapping, the integrated controller does not support hardware RAID.

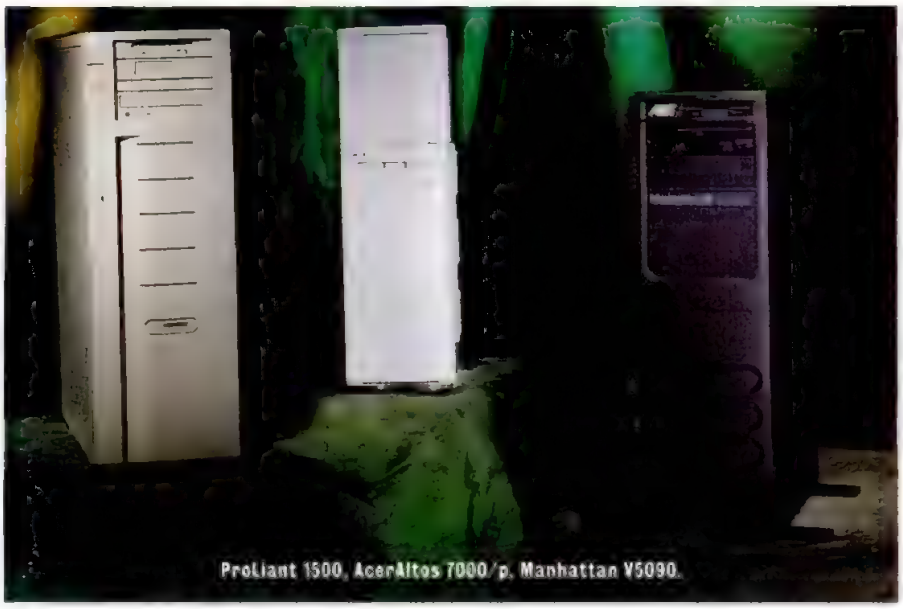
The unit's Pentium/90 processor is mounted on a proprietary processor card. This card integrates two ZIF sockets for a multiprocessing future, 512K of cache, and four additional SIMM banks, which complement the four banks on the motherboard and bring the system's memory maximum to 256MB.

The AcerAltos 7000/p's performance didn't live up to its solid design. With a maximum workstation load, its throughput was less than half that of leading systems; at all workstation loads, it was consistently below average. CPU utilization, however, was low, among the middle tier of units.

Acer America Corp. provides a three-year warranty with the AcerAltos 7000/p, with on-site service included for the duration.—*William P. Flanagan*

Acer America Corp., *San Jose, CA; 800-733-2237, 408-432-6200; fax, 408-922-2933.*

Circle 441 on reader service card



ProLiant 1500, AcerAltos 7000/p, Manhattan V5090.

AST Research Inc.

Manhattan V5090

The $13,494 AST Manhattan V5090 offered fair performance and included AST's basic server management software, Percepta. It lacks amenities such as hot-swappable drives and standard ECC memory, however, and AST chose to use an ungainly combination of EISA and PCI Ethernet adapters.

AST also markets the Manhattan G, a workgroup server, and the Manhattan P, for distributed enterprise networks.

The Pentium/90-based Manhattan V came in at about the middle of the pack on our throughput tests. On the downside, it ran up the highest CPU utilization of all the servers in this roundup. Even after PC Labs optimized NetWare parameters, the system showed only minimal performance gains.

The likely reason for such high utilization was the server's configuration. Most other vendors' servers had either one PCI quad Ethernet adapter or four EISA adapters. AST installed two EISA and two PCI adapters, a less efficient solution than the single quad Ethernet NIC offered by some vendors.

AST embedded a Fast SCSI controller on the unit's motherboard. The system's CPU and memory reside on a processor card. And, as in Hewlett-Packard Co.'s system, to upgrade memory you must remove this card from the unit.

Although you can access the seven drive bays from the front of the unit, the system's hard disks are not hot-swappable.

Percepta tracks components as well as system temperature. With the addition of an optional modem, basic beeper notification is available. Otherwise, the only way network managers are notified is if they are sitting in front of the management station.

AST Research offers three-year on-site service, including parts-and-labor coverage, with the Manhattan V.—*Padraic R. Boyle*

AST Research Inc., *Irvine, CA; 800-876-4278, 714-727-4141; fax, 800-926-1278.*

Circle 442 on reader service card

SUITABILITY TO TASK

Manhattan V5090

Performance	Fair
Security Fault tolerance	Fair
Expandability Scalability	Good
Server management	Fair

Compaq Computer Corp.

ProLiant 1500

The $17,848 Compaq ProLiant 1500 is a departmental server that can't steer you wrong. The EISA/PCI-based unit includes five bays fitted for hot-swappable drives, integrated Fast/Wide SCSI-2 support, ECC memory, great performance, and a server management package that is rivaled by none in this roundup. It's priced slightly higher than comparable offerings from Digital Equipment Corp. and Hewlett-Packard Co. and it doesn't offer their

bridged-PCI bus designs, but it's otherwise competitive with the very best in this roundup.

Compaq also markets the ProSignia VS, ProSignia 300, ProSignia 500, ProLiant 2000, and ProLiant 4000 servers. The three ProSignias are single-processor workgroup servers. The ProLiant 2000 line offers high-end dual-processing systems and the top-of-the-line ProLiant 4000 models feature four processors.

SUITABILITY TO TASK	
ProLiant 1500	
Performance	Excellent
Security/ Fault tolerance	Good
Expandability/ Scalability	Good
Server management	Excellent

The ProLiant 1500's internal design is neatly laid out, with all components easily accessible. The drive bays plug into a backplane card that connects them to the motherboard's integrated SCSI-2 controller. The chassis is built to support disk hot-swapping, although the integrated controller would need to be upgraded before it could support hardware-based RAID. The system we tested used four 1GB Fast SCSI-2 hard disks, although the controller can handle Fast/Wide SCSI-2 drives.

There is one proprietary slot on the motherboard for the processor card. The card in the tested configuration contains one ZIF socket for the installed 100-MHz Pentium processor (it also supports the 75-MHz version) and six SIMM slots. Unlike its predecessor, the Compaq ProLiant 1000 486DX2/66, which won the Editors' Choice in our last review of departmental file servers ("File Servers: Data on Demand," October 11, 1994) the ProLiant 1500 will have a dual-processor card available.

On our benchmark tests, the ProLiant 1500 was among the best performers overall. Only the entry from DFI had better throughput; the ProLiant 1500's CPU utilization was among the group's lowest.

Compaq's SmartStart Installation Guide, which rivals the type of step-by-step guides that accompany the best home PCs, eases system setup. The Guide's perfect complement is the Support Software CD, from which you can create disks with copies of the help files for whichever operating system you have chosen.

Compaq's SmartStart allows network administrators to pick and install a network operating system (NOS). There are CDs included for NetWare 3.*x* and 4.*x*, Microsoft Windows NT, SCO Unix, and OS/2 as well as CDs to install an Oracle or SQL database. A 15-step setup guide walks you through the installation of SmartStart and your chosen NOS. SmartStart will also help you install Compaq Insight Manager, Compaq's server management software. Insight Manager provides all the necessary server management and monitoring functions and adds full remote notification as well as remote server access.

The ProLiant 1500 has a three-year parts-and-labor warranty with on-site service included for the duration.—*WPF*

Compaq Computer Corp., *Houston, TX; 800-345-1518; fax, 713-378-1442.*

Circle 443 on reader service card

DFI

Diamond P100 Server

The DFI Diamond P100 Server ($26,583 list, $20,500 street) was among the best performers on our benchmark tests. Although it has first-rate components, it offers few of the amenities we expect in a full-blown departmental server. There are other systems reviewed that also offer top-tier performance while integrating more server-specific design features such as hot-swappable hard disks, EISA/PCI-based motherboards, and complete server management packages. This machine makes sense if top-notch performance is more important to you than high availability of features, server management capabilities, or a low price.

SUITABILITY TO TASK	
Diamond P100 Server	
Performance	Excellent
Security/ Fault tolerance	Fair
Expandability/ Scalability	Fair
Server management	Good

DFI does offer a more robust file server with both ECC memory and an EISA/PCI motherboard. The company also offers a line of application servers based on the PowerPC and supporting two to eight processors.

The Diamond P100 that we tested used a 100-MHz Pentium processor installed on an ISA/PCI-based motherboard. The unit came configured with two 1.7GB Fast/Wide SCSI-2 hard disks connected to a Mylex controller with 4MB of disk cache. This controller helps boost performance but adds about $1,700 to the total cost of the system.

On our NetBench tests, the Diamond P100 was consistently among this roundup's best. Throughput grew steadily as workstations were added, and its CPU utilization was the lowest overall with the maximum 60-workstation load. Unlike some of the other companies represented here, DFI managed to tune its system extremely well so that even after PC Labs tuned NetWare further, performance was enhanced only marginally.

Server management came in the form of Managewise, a package developed by Intel and Novell that manages both the server and the network. The software offers both local and remote notification (via a console or a pager), and has the ability to monitor drive failures, CPU utilization, and server traffic.

DFI provides a two-year warranty on parts and a lifetime warranty on labor, with on-site service an additional $58 per year.—*WPF*

DFI, *Sacramento, CA; 800-808-4334, 916-568-1234; fax, 916-568-1233.*

Circle 444 on reader service card

Digital Equipment Corp.

Prioris HX 590 Server

The Prioris HX 590 Server is an impressive showcase of Digital Engineering Corp.'s engineering and design capabilities. This server has one of the most advanced designs in this roundup and, with its bridged PCI buses, clearly shows that Digital is looking and leaping toward the future. The Pentium/90-based unit's $17,900 street price is roughly average for servers in this roundup. The Prioris HX was anything but an average performer, though: It was among the best of this roundup, showing that sometimes function does follow form. Digital also markets the Prioris XL line of midrange servers and the Prioris MTE line of entry-level servers.

Digital separated the motherboard

Benchmark Tests: Departmental File Servers

The benefit of PCI buses and Fast/Wide SCSI-2 hard disk interfaces is clear. IBM's Micro Channel architecture (MCA) also drove performance to impressive levels. We found that proper tuning of NetWare is critical, and that not all vendors tuned their servers optimally.

What the Numbers Mean

Total Network Throughput leaders combine fast hardware (including PCI-based network interface cards) with careful tuning of NetWare parameters. Their performance bumps up against a ceiling imposed by the 40-megabit-per-second (Mbps) maximum combined bandwidth of our four Ethernet segments rather than any server bottlenecks. Their relatively low CPU Utilization results (indicating better performance) show that these Pentium servers have plenty of headroom left before they run out of processing power.

At the low end of the performance charts are servers that used EISA-based NICs or a combination of EISA- and PCI-based NICs, both of which are less efficient than PCI NICs.

To remove software tuning's influence and compare the raw capabilities of the hardware, we also retested all units using our standardized set of tuned NetWare parameters. These results are in the Total Network Throughput (PC Labs–Tuned) chart. We do not report PC Labs–tuned results for the GAIN Vector EPD 100, because its controller was incompatible with the 16K block-size setting we specified in NetWare.

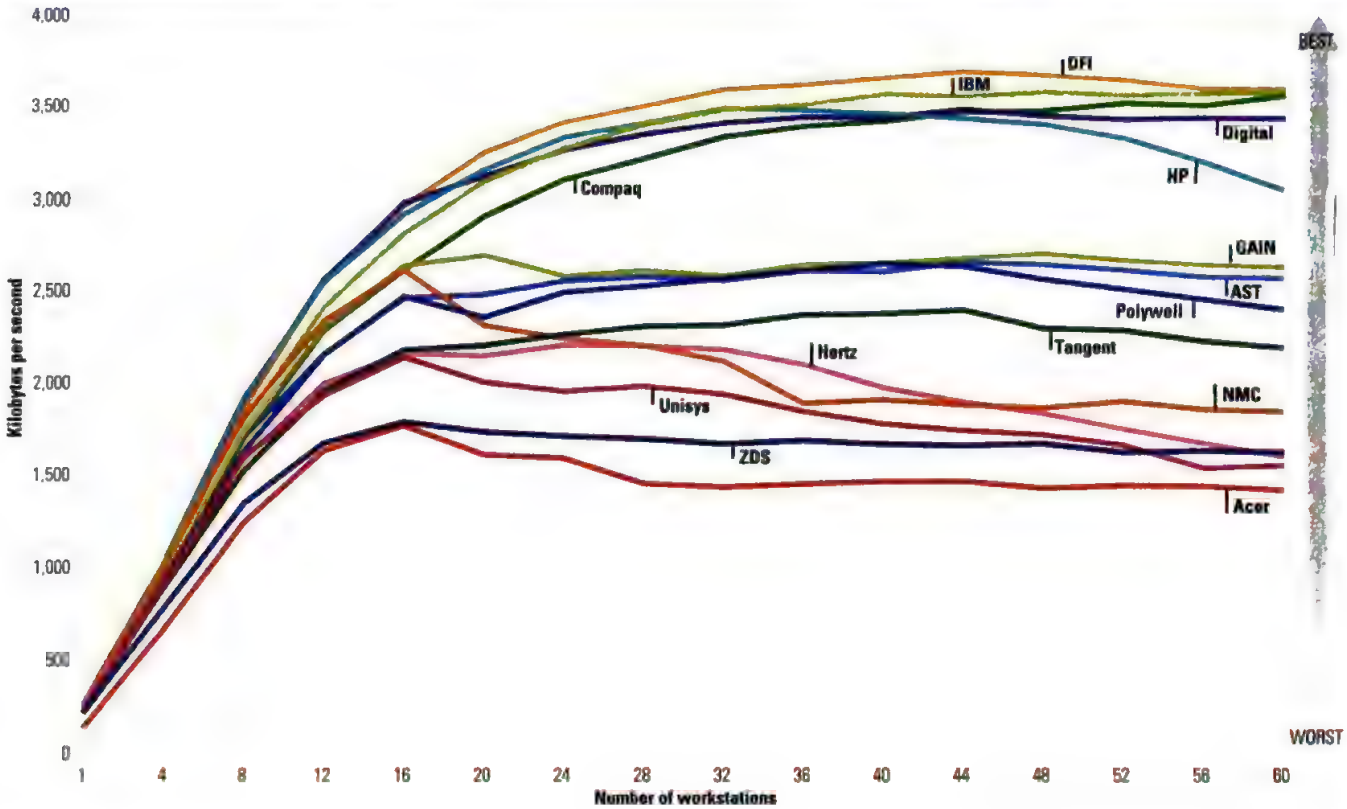
To maximize performance, PC Labs' tuning parameters (among other things) disable the ability to salvage deleted files. They also use 16K block sizes that can waste disk space. These are trade-offs you may not be willing to make.

PCI MEANS PERFORMANCE

PCI is a cornerstone technology in all the leading servers except for one, the MCA-based IBM PC Server 500. Today, PCI is usually mated with EISA to provide backward-compatibility. But PCI holds a number of advantages over EISA, not the least of which is speed. PCI supports a 132-megabyte-per-second (MBps) maximum data-transfer rate, as opposed to EISA's 33-MBps peak. (In reality, the Neptune chip set used in all these PCI-based servers, except Compaq Computer Corp.'s ProLiant 1500, limits throughput to about 40 MBps.) As high-performance standards such as 100Base-T are deployed, this added bandwidth will become increasingly important. Ultimately, we expect PCI-only servers to displace PCI/EISA combinations. Even today there's good reason to opt for PCI NICs, and today the most effective choice is a quad Ethernet NIC.

A downside of PCI is that because of its high speed, it

TOTAL NETWORK THROUGHPUT



supports a relatively small number of electrical loads. A *load* is the electrical burden imposed by any device plugged into the bus. In practical terms, a single PCI bus can handle no more than three or four expansion cards reliably.

To skirt this limitation, two vendors—Digital Equipment Corp. and Hewlett-Packard Co.—added a bridged PCI bus to their servers. This bridged bus acts as a slave to the primary PCI bus, allowing more PCI slots (although a slight *latency*, or delay, is imposed in routing data across the bridge). A more sophisticated solution that we expect later this year employs dual PCI buses, in which two peer PCI buses connect to the CPU, adding slots without imposing additional latencies.

Both Digital's and HP's configurations suffered minor shortcomings. Digital chose to use four NICs rather than the quad PCI NICs used by many vendors, which left only one PCI slot unoccupied. HP integrated two Fast SCSI-2 controllers onto its PCI bus, but these controllers do not support the Fast/Wide SCSI-2 hard disks that HP uses.

There are two alternatives to using a single PCI NIC; both sap performance. The first is to use EISA NICs in a PCI/EISA system; the second is to mix EISA and PCI NICs. Servers from Acer America Corp., Unisys Corp., and Zenith Data Systems—all using four EISA NICs—were among the worst performers on our tests. The AST Manhattan V5090, which used two PCI and two EISA NICs, had average performance. Only the ProLiant 1500, with four Compaq NetFlex-2 EISA NICs, turned in excellent performance, a result we attribute to its optimized TriFlex/PCI architecture.

How do we know the NICs are at fault? We took one of the fastest PCI-based units, the Digital Prioris HX 590, and replaced its PCI NICs with four Eagle NE3200 EISA cards (industry-standard products known to be reliable and efficient). Overall throughput dropped by nearly 30 percent.

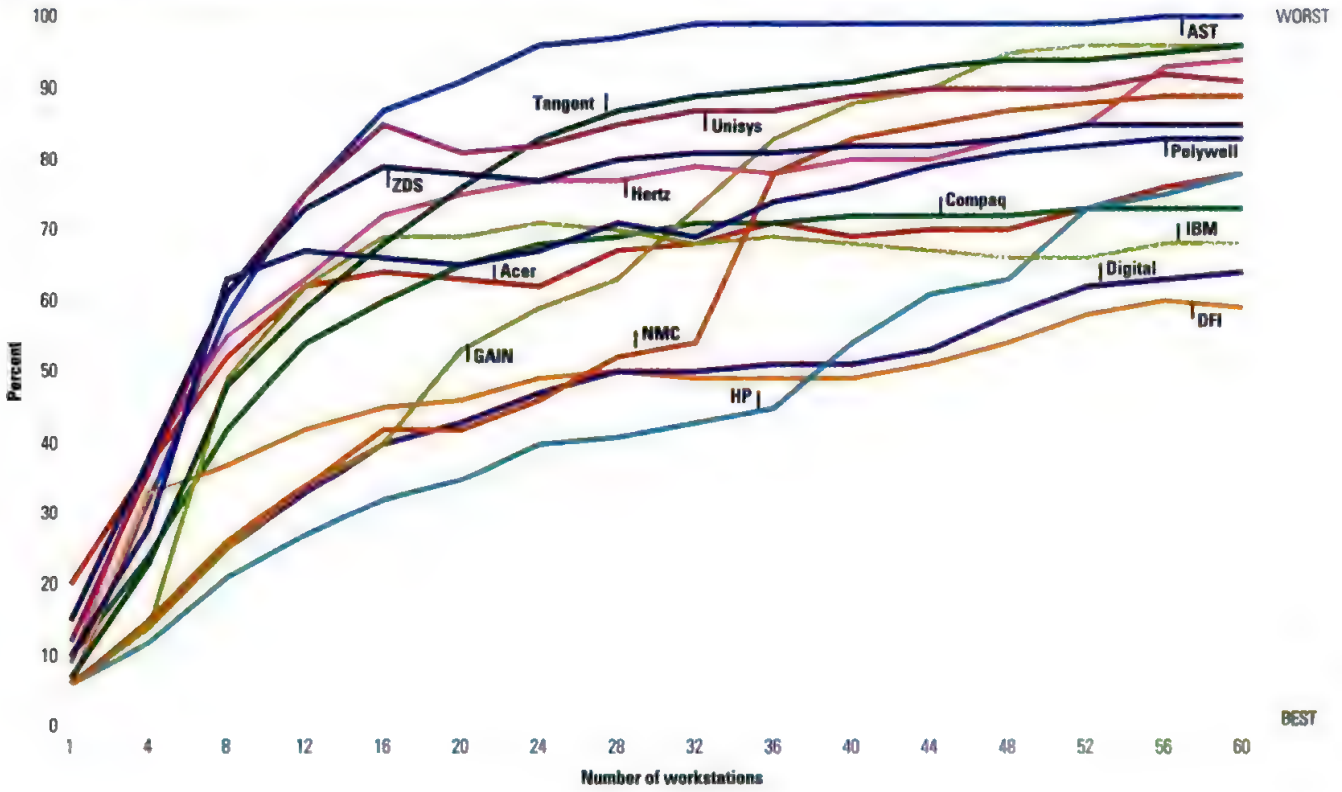
MICRO CHANNEL: FAST, BUT WHAT ABOUT THE FUTURE?

The only top performer that bucked the PCI trend was the MCA-based IBM PC Server 500. MCA bus-transfer rates are normally 20 MBps, but the IBM PS/2 Server 95 (not reviewed) and PC Server 500 each use a 40-MBps streaming data-transfer mode. In the light of the high throughput and low CPU utilization of the PC Server 500, IBM has done this design right. The downside of MCA is that it locks you into what is effectively a proprietary solution, which won't offer the variety of adapter cards that will be available for PCI.

FAST/WIDE SCSI ARRIVES

File servers' performance depends largely on their disk subsystems' speed. Although Fast/Wide SCSI-2 disks have been available for some time, this is the first time we've seen controller technology and bus support able to take advantage of Fast/Wide SCSI's added throughput (as opposed to that of the more commonplace Fast SCSI-2). We expect differences would be even more pronounced if the fastest servers here had not been *wirebound*—that is, limited in performance by

CPU UTILIZATION



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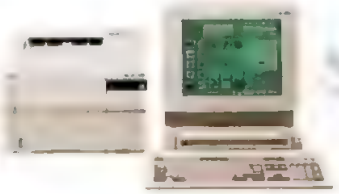

Electronic Filing System Canofile 510

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Canon

CIRCLE 258 ON READER SERVICE CARD

the physical signaling speed of the Ethernet segments.

A caveat: Some major vendors chose Fast/Wide implementations only as an upgrade. HP has Fast/Wide drives but uses embedded Fast—but Narrow—controllers. Compaq integrates a Fast/Wide controller, but its drives were Fast alone. Both systems took small but noticeable hits on our CPU utilization tests, throughput tests, or both, and didn't perform as well as pure Fast/Wide systems.

RAID: FOR SAFETY, PERFORMANCE

RAID (redundant array of inexpensive disks) technology is best known for its data-protection capabilities, but it can also impact performance. In order to test systems on a level playing field, we disallowed hardware RAID support and instead tested all machines using NetWare's software-striping capability. In anecdotal testing, we found hardware RAID Level 0 (which provides no redundancy but simply stripes data) improved performance by 10 to 15 percent.

Systems from Digital, DFI, GAIN Systems, IBM, Polywell Computers, and Unisys ship with disk controllers capable of supporting hardware RAID, and most others offer it as an option.—*Analysis by Tom Kreyche*

How We Tested

We tested these departmental file servers under NetWare 3.12. Our 60-node network at PC Magazine Labs, West Coast, consisted of four identical Ethernet segments, each composed of ten 486DX/33 PCs and five 386DX PCs from various manufacturers.

We presented 16 different load conditions to each server. We began with one workstation, ran the test again with four, then repeated the test, adding four workstations at a time until we reached a maximum load of 60 clients.

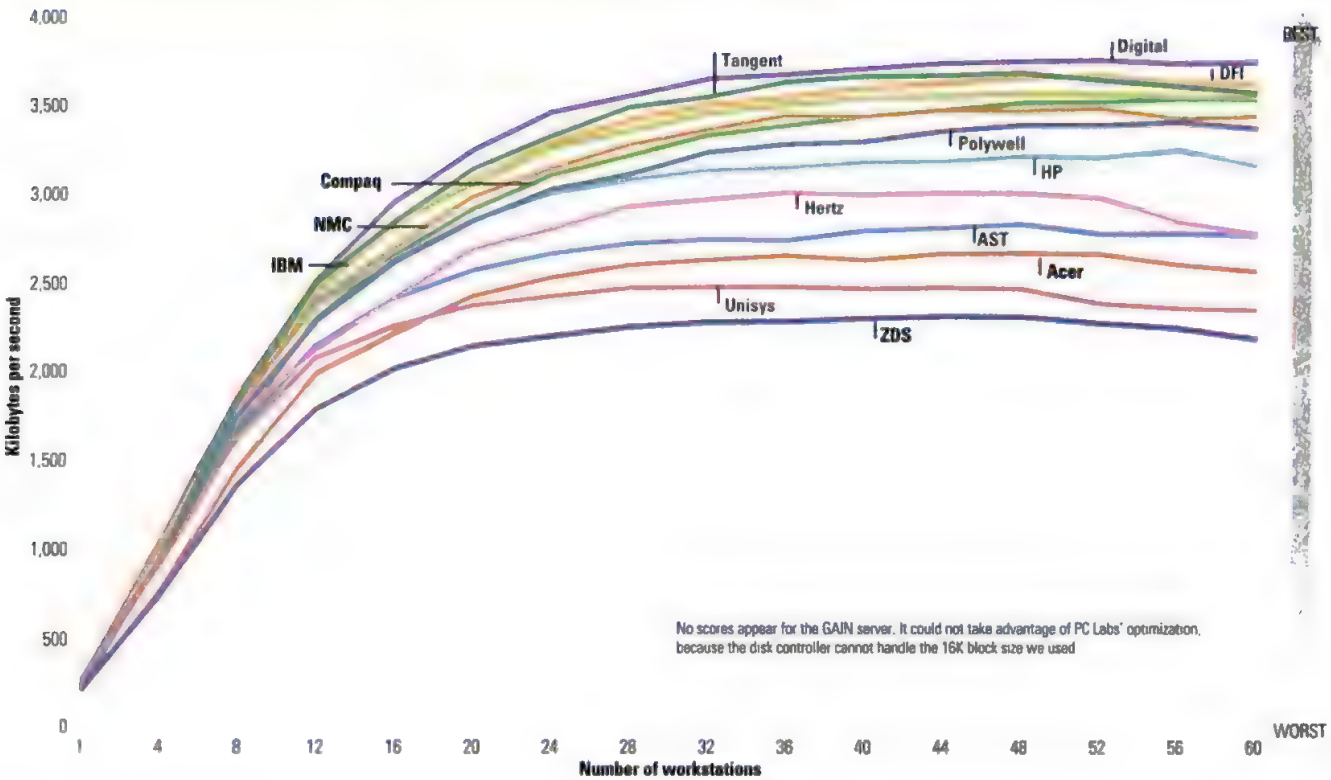
Total Network Throughput results are generated by the Disk Mix portion of NetBench, Version 3.0. Disk Mix mimics the way eight leading PC applications perform network file operations on a server. It creates and deletes binary and text files, moves data in different-size chunks, and intersperses read and write operations. We set NetBench to create a 20MB workspace on the server for each workstation.

NetBench presents requests through NetWare client software running on each workstation. Since in the course of each test multiple workstations are constantly firing requests at the server, results of a test with a given number of NetBench nodes represent a traffic load more typical of a larger network using less demanding workstations.

Disk Mix runs for 11 minutes at each load level to ensure stable and repeatable results. During the runs, we use NetWare's STAT.NLM utility to monitor CPU utilization at 1-second intervals. Using this information, we generate **CPU Utilization** scores. STAT.NLM uses minimal CPU resources and is considered a fixed overhead in all tested servers. We disable server management software during testing to eliminate potential CPU overhead.

To mimic the performance buyers would see, we required all vendors to specify the configuration parameters in NetWare's STARTUP.NCF and AUTOEXEC.NCF files. (All vendors had the opportunity to obtain NetBench and use it to tune their systems.) For **Optimized Total Network Throughput** results, we tested all systems with our own versions of these files, which we optimized for Disk Mix.

OPTIMIZED TOTAL NETWORK THROUGHPUT



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[illegible]	Yes	No	No
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[illegible]	Yes	Yes	No
[illegible]	Yes	Yes	No

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yes It runs with NetWare

CIRCLE 299 ON READER SERVICE CARD

Prioris HX 590 Server, Diamond P100 Server, Vector EPD 100.

and electronic components from mass-storage devices, using a design similar to that of the HP NetServer LH. In doing so, Digital included or accommodated just about every feature you need in a departmental server. On one side of the case, you'll find two separate PCI buses with three slots each. Two of the primary PCI slots are filled with a NIC and a Mylex controller card with 4MB of disk cache installed. The secondary PCI slots are filled with three more NICs.

Additionally, the machine has six EISA slots. The single occupied EISA slot held a Digital RSM fail-safe hardware controller card. This controller card connects to a remote workstation and comes with an external power supply. Therefore, it is not dependent on the server for power; nor does it need the hardware or the operating system to access the server. It also has its own real-time clock. The card acts as a separate connection to the server and allows access to the server in a worst-case scenario. Although this controller card is by no means an alternative to a full-fledged server management package, it is a useful and unique tool for the network administrator.

Two proprietary slots are also provided on the motherboard. One is for the memory card, the other for a processor card with two ZIF sockets.

On the other side of the case there are seven hot-swappable disk drives and two additional standard 5.25-inch drive bays. Two drive bays are dedicated to the 3.5-inch floppy disk drive and the CD-ROM drive. There is also a cutout to install a redundant power supply.

SUITABILITY TO TASK

Prioris HX 590

Performance	Excellent
Security/ Fault tolerance	Excellent
Expandability/ Scalability	Excellent
Server management	Excellent

The Prioris HX's throughput placed it in the top tier of units in this roundup; only one system had a lower overall CPU utilization rate. When PC Labs further tuned the unit's NetWare parameters, its throughput was best overall—an indication of the system's solid group of hardware components.

This quality machine also comes with quality coverage. Digital includes a three-year parts-and-labor warranty that includes on-site service for the duration of the warranty.—*WPF*

Digital Equipment Corp., *Acton, MA; 800-344-4825, 508-493-5111; fax 508-493-8780.*

Circle 445 on reader service card

GAIN Systems Inc.

Vector EPD 100

The Vector EPD 100 from GAIN Systems has a list price of $12,095 and a street price of $11,000, which makes it an affordable alternative to some of the higher-priced servers in this roundup. The system offers average performance and tremendous expandability—twice that of most reviewed units. But it does lack the amenities that some of the other servers in this roundup offer, such as hot-swappable hard disks or software to help to configure your NOS.

With 16 drive bays, the Vector's tower case was one of the largest in this roundup. The inside of the case is cavernous and it contains accommodations for a second motherboard. There are screw holes for mounting and cutouts for 11 expansion-card slots, plus I/O and keyboard ports. It's enough to make you wonder whether you could run two completely separate servers from within the same box. We're not sure what benefits that would have brought you, and apparently GAIN had a different intention in allowing so much space. The company says the extra room is not for a second full-fledged server but for a communications or dial-in server, or a router. The single motherboard that was installed offered six EISA and four PCI slots.

The Vector's throughput was about average and actually among the best of the middle-tier performers. Its CPU utilization was high, however. PC Labs attempted to tune NetWare further to see if the system's performance could be improved but was foiled because the unit's QLogic disk controller could not handle the 16K block sizes that we used.

Although the Vector doesn't support hot-swapping of its hard disks, it does provide fault tolerance in the form of redundant power supplies, which are controlled by an internal conversion box. The box, in the event of a loss of power by one supply, will transfer power to the second supply and sound an alarm. This isn't as sophisticated an approach as you'll find in machines that ship with extensive server management capabilities, which provide features such as remote notification. Most other cases also don't have the internal space to fit this type of conversion box.

SUITABILITY TO TASK

Vector EPD 100

Performance	Good
Security/ Fault tolerance	Good
Expandability/ Scalability	Good
Server management	Good

GAIN's choice for server management software was Hewlett-Packard's NetServer Assistant 2.0 ($495, included in system price above). This tool can restart the server when it hangs or provide information such as what's installed

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CIRCLE 147 ON READER SERVICE CARD

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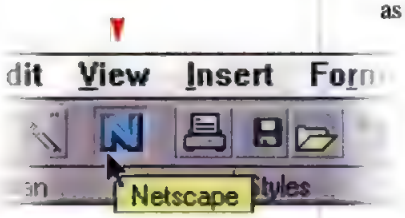

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in the system's slots or its current CPU utilization. It has limited remote-notification features, however, and local notification is confined to an on-screen warning.

The Vector is backed by a two-year parts-and-labor warranty; the cost of on-site service depends on the configuration and response time you need. —*WPF*

GAIN Systems Inc., *Norcross, GA; 800-849-4246, 404-446-2026; fax, 404-446-2028.*

Circle 446 on reader service card

Hertz Computer Corp.

Hertz P100e

The Hertz P100e is one of those systems trying valiantly to be something they aren't—in this case, a departmental file server. Despite its attractive price of $9,875, it has significant limitations. It met all of our filter criteria, but it is, at best, a high-end workstation or a low-end workgroup server.

SUITABILITY TO TASK	Hertz P100e
Performance	Fair
Security/ Fault tolerance	Poor
Expandability/ Scalability	Poor
Server management	Fair

Though Hertz offers EISA-based systems, the unit we tested had an ISA/PCI motherboard. On our tests, its throughput was consistently among the bottom group of units, and its CPU utilization was among the highest in the roundup. With tweaking of NetWare parameters, PC Labs managed to boost the system's performance into the average range.

The tower case has only three drive bays available. The installed hard disks are not hot-swappable. With only one PCI slot left available and no EISA slots, the motherboard is limited, and, in the light of some of the other more advanced motherboard designs in this roundup, it is quickly becoming outdated in the server world.

Hertz included Frye's Statistics Display Rack for NetWare as a form of server management. This software monitors the server's configuration and measures hard disk and CPU utilization with graphical displays of server statistics.

The warranty on the system, one year for parts and labor, is more in line with that of an average desktop system than with that of a server. On-site service costs an additional $495 per year.—*WPF*

Hertz Computer Corp., *New York, NY; 800-232-8737, 212-684-4141; fax, 212-684-3658.*

Circle 447 on reader service card

SUMMARY OF FEATURES

List price (tested configuration) The prices include server management and setup software supplied with the tested machines but not the cost of NetWare 3.12, which averages about $4,000 for a 100-user license.

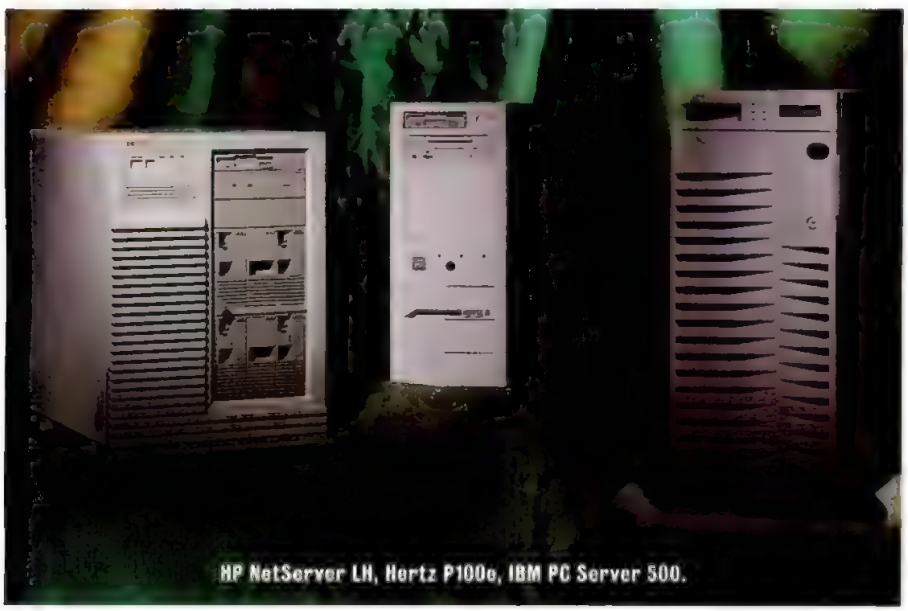
Maximum RAM on motherboard indicates how much RAM the motherboard accommodates, while total indicates the maximum amount of RAM the server supports on the motherboard and daughterboards together.

Power supply Some servers use multiple power supplies. In most cases these are redundant, so that the server will continue to run even if one fails. The exception is the Unisys SME 510010, which uses one power supply for the mass-storage subsystem and one for electronic components.

Easily swappable, hot-swappable disks Some servers provide hard disks that are easy to replace—you can remove them without opening the case or loosening screws. Support for hot-swapping—the ability to pull out the hard disk while the server is running and replace it—requires easy removability plus a controller that supports hardware RAID.

Remote alert via pager, modem, SNMP If the included server management software supports remote alert via pager, modem, or SNMP but lacks the hardware to use these features, we indicate the feature is *optional*.

Includes hardware, NOS-setup software Hardware or network operating system–setup software simplifies the installation process of hardware components or the NOS.



HP NetServer LH, Hertz P100e, IBM PC Server 500.

Hewlett-Packard Co.

HP NetServer LH

PC MAGAZINE EDITORS' CHOICE

Hewlett-Packard's $14,450 (street price) Pentium/100-based NetServer LH boasts above-average performance, flexibility, and expandability. Combined with an excellent design and a comprehensive installation solution, it also proved to be one of the most impressive servers we tested.

HP markets the NetServer LC, LF, and LM lines in addition to the LH line. The LC is a single-CPU, entry-level line, whereas the LF is slightly more advanced and has greater expandability. The LM line shares many of the LH line's advanced features, including dual-processing capability, but supports EISA only.

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SUMMARY OF FEATURES

Departmental File Servers

■ YES ▫ NO
Products listed in alphabetical order

	AcerAltos 7000/p	AST Manhattan V5090	Compaq ProLiant 1500	DFI Diamond P100 Server	Digital Prioris HX 590 Server (PC MAGAZINE EDITORS' CHOICE)	GAIN Vector EPD100	Hertz P100e	HP NetServer LH (PC MAGAZINE EDITORS' CHOICE)
List price (tested configuration)	$15,500	$13,494	$17,848	$20,499 (street)	$17,900 (street)	$10,950 (street)	$9,875	$14,450 (street)
Processor	Pentium/90	Pentium/90	Pentium/100	Pentium/100	Pentium/90	Pentium/100	Pentium/100	Pentium/100
Supports multiple processors	■	■	■		■	■		■
Installed RAM	128MB	128MB	128MB ECC	128MB	128MB ECC	128MB	128MB	128MB
Hard disk capacity (and interface)	Four 1GB (Fast SCSI-2)	Four 1GB (Fast SCSI-2)	Four 1GB (Fast SCSI-2)	Two 1.8GB (Fast/Wide SCSI-2)	Four 1GB (Fast/Wide SCSI-2)	Four 1GB (Fast/Wide SCSI-2)	Two 1.8GB (Fast/Wide SCSI-2)	Four 1GB (Fast/Wide SCSI-2)
Hard disk controller (and interface)	Integrated Adaptec AIC-7870P (Fast/Wide SCSI-2)	Integrated NCR 53C810 (Fast SCSI-2)	Integrated Compaq 32-bit PCI (Fast/Wide SCSI-2)	Mylex DAC960P (Fast/Wide SCSI-2)	Mylex DAC960P (Fast/Wide SCSI-2)	QLogic FastSCSI IO PCI (Fast/Wide SCSI-2)	Adaptec AHA-2940W (Fast/Wide SCSI-2)	Integrated Adaptec 7850 PCI/SCSI (Fast SCSI-2)
Network interface cards (and interface)	Four Eagle NE3200 (EISA)	Two SMC EtherPower SMC8432EA (PCI), two 3Com EtherLink III (EISA)	Four Compaq NetFlex-2 (EISA)	One Cogent EM964 PCI TP Quartet (PCI)	Four Digital EtherWorks PCI Turbo DE435 (PCI)	One Xpoint PCI Quad Ethernet PeerSwitch (PCI)	One Cogent EM964 PCI TP Quartet (PCI)	One Cogent EM964 PCI TP Quartet (PCI)
Expandability								
Maximum RAM on motherboard: total	128MB, 256MB	None, 256MB	208MB, 208MB	128MB, 128MB	512MB, 512MB	512MB, 512MB	128MB, 128MB	None, 192MB
Number of SIMM sockets in use, total	4, 4	8, 8	4, 6	4, 4	4, 8	4, 8	4, 4	4, 6
Expansion-bus slots	Four EISA, two PCI, one EISA/PCI	Five EISA, two PCI, one EISA/PCI	Five EISA, two PCI, one EISA/PCI	Four ISA, two PCI, one ISA/PCI	Six EISA, six PCI	Six EISA, four PCI	Three ISA, three PCI, one ISA/PCI	Four EISA, four PCI, one EISA/PCI
Accessible drive bays (5.25", 3.5")	3, 9	2, 7	3, 5	4, 1	3, 8	16, 0	4, 1	2, 7
Internal drive bays (5.25", 3.5")	0, 0	0, 0	0, 0	2, 1	0, 0	0, 0	0, 4	0, 0
Power supplies	One 350W	One 300W	One 325W	One 250W	One 450W	Two 300W	One 300W	One 350W
Installed/maximum external CPU cache	512K, 512K	256K, 512K	256K, 256K	256K, 256K	512K, 512K	256K, 512K	256K, 1MB	256K, 512K
Security and Fault Tolerance								
Easily swappable/hot-swappable disks	■ ▫	■ ▫	■		■ ■	▫ ▫	▫ ▫	■ ▫
Lockable hard disk subsystem	■	■	■		■	■	▫	■
Lock for power/reset button	▫ ▫	■ ■	N/A		■ ■	■ ■	▫	▫ ▫
Lock for front panel/case	▫ ■	■ ▫	■		■ ■	■		▫ ▫
Provided controller supports hardware RAID		▫		■	■	■		▫
Server Management								
Included server management software	Acer Server Manager	AST Percepta Server Manager	Compaq Insight Manager	Novell's ManageWise	Digital Remote Server Manager	HP NetServer Assistant 2.0	Frye Statistics Display Rack for NetWare	HP NetServer Assistant 2.2
Modem included	▫	▫	▫		■			▫
Provides asset management/network management/fault tracking	▫ ▫ ■	■ ▫ ▫	■ ■ ■	■ ■ ■		▫ ■	■ ■ ■	■ ■ ■
Local alerts via console/audible alarm	■ ■	■ ■	■ ■	■ ■	■ ■	■	■	■ ■
Remote alert via pager/modem	■ ■	▫ ▫	■ ■	■ ▫	■ ■		▫	Optional Optional
Remote alert via SNMP	▫	■	■	■		■	▫	■
Includes hardware/NOS-setup software	▫ ▫	▫	■ ■		■			■ ▫
Service and Support								
7-day, 24-hour live technical support	■	■	■					▫
Standard warranty on parts/labor	3 years/3 years	3 years/3 years	3 years/3 years	2 years/Lifetime	3 years/3 years	2 years/2 years	1 year/1 year	3 years/3 years
On-site service charge (and term)	Included (3 years)	Included (3 years)	Included (3 years)	$58 (1 year)	Included (3 years)	Varies	$495 (1 year)	Included (3 years)

N/A Not applicable. The product does not have this feature

fered by this server is its drive subsystem. This subsystem is broken down into two internal disk drive chassis and two integrated PCI SCSI adapters. Each chassis can accommodate up to three hard disks, for a total of six front-accessible drives. The unit can run with either one or both channels. You can arrange and distribute the drives to suit your needs—in fact, they come standard in a duplexed configuration that provides added redundancy.

Although the unit's chassis allows disk hot-swapping, you will need to upgrade the controller for hardware RAID.

The drive chassis supports both Fast and Fast/Wide drives, but the integrated SCSI-2 controllers are only Fast. HP servers have Fast/Wide drives standard; to take full advantage of them, all you need is a new adapter. NetServer LH models with a disk array controller do support Fast/Wide drives.

The system integrates IDE, SCSI, and graphics controllers, but keeps an eye to the future with abundant PCI slots. Like Digital's system, HP's unit daisy-chains a secondary PCI bus off the primary PCI bus with a PCI-to-PCI bridge chip.

The NetServer LH supports a single 75-MHz or one or two 100-MHz Pentium

SUITABILITY TO TASK

HP NetServer LH	
Performance	Excellent
Security/Fault tolerance	Good
Expandability/Scalability	Excellent
Server management	Excellent

IBM PC Server 500	NMC Expert Server	Polywell Poly 500D2	Tangent Just'N'Case SMP 100	Unisys SME 510010	ZDS Z-Server WG5
$22,880	$9,556	$11,000 (street)	$12,990	$20,307	$13,500
Pentium/90	Pentium/100	Pentium/100	Pentium/90	Pentium/100	Pentium/90
■	■	■	■	■	■
128MB ECC	128MB	128MB	128MB	128MB ECC	128MB
Four 1GB (Fast/Wide SCSI-2)	Four 1GB (Fast/Wide SCSI-2)	Three 1GB (Fast/Wide SCSI-2), one 80MB (SCSI)	Four 1GB (Fast SCSI-2)	Four 1GB (Fast SCSI-2)	Four 1GB (Fast SCSI-2)
IBM Streaming-RAID Adapter/A (Fast/Wide SCSI-2)	Adaptec AHA-2940W (Fast/Wide SCSI-2)	Mylex DAC960P (Fast/Wide SCSI-2)	Adaptec AHA-2940 (Fast SCSI-2)	Mylex DAC960E (Fast SCSI-2)	Integrated Adaptec 7870 (Fast SCSI-2)
Four IBM EtherStreamer MC32 (MCA)	One Cogent EM964 PCI TP Quartet (PCI)	One Znyx EtherArray ZX314 (PCI)	One Cogent EM964 PCI TP Quartet (PCI)	Four SMC EtherCard Elite32C Ultra (EISA)	Four Eagle NE3200 (EISA)
256MB, 256MB	512MB, 512MB	512MB, 512MB	512MB, 512MB	None, 1GB	256MB, 256MB
8, 8	4, 6	4, 4	4, 8	8, 16	8, 8
Eight MCA	Three EISA, three PCI, one EISA/PCI	Three ISA, three PCI, one ISA/PCI	Five EISA, two PCI, one EISA/PCI	Six EISA, three VLB	Five EISA, two PCI, one EISA/PCI
4, 18	5, 2	8, 0	8, 0	11, 2	3, 0
0, 0	1, 1	2, 0	0, 0	0, 0	0, 4
One 438W	Two 300W	One 250W	Two 300W	One 350W	One 230W
512K, 512K	256K, 512K	512K, 512K	256K, 512K	256K, 512K	256K, 256K
■■	■■	■■	■■	■■	■■
■	■	■	■	■	■
■ N/A	■■	■■	■■	■■	■■
■■	■■	■■	■■	■■	■■
■	■	■	■	■	■
IBM NetFinity 2.01	None	None	Intel LANDesk Manager	VisiSoft VisiNet	None
■	■	■	■	■	■
■■■	■■■	■■■	■■■	■■■	■■■
■■	■■	■■	■■	■■	■■
Optional Optional	■■	■■	Optional Optional	■■	■■
■	■	■	■	■	■
■■	■■	■■	■■	■■	■■
■	■	■	■	■	■
3 years/3 years	3 years/3 years	5 years/5 years	3 years/1 year	3 years/3 years	3 years/3 years
Included (3 years)	$39 (1 year)	$200 (1 year)	$295 (1 year)	Included (3 years)	Included (3 years)

CPUs on a processor card, which integrates main memory as well. When upgrading memory you must remove this card to gain access to the SIMM banks. Although the unit we tested did not include ECC memory, HP says ECC memory is now shipped standard with LH servers.

On our tests the NetServer LH was always near the top of the pack. Its CPU utilization was also one of the three lowest in the test group.

NetServer Navigator, HP's bootable CD-ROM, is similar to Compaq's SmartStart and IBM's ServerGuide. Navigator consists of four applications to ease server installation and management burdens. Just install the adapters in the system and it will walk you through EISA/PCI adapter configuration.

Though Navigator does not install the NOS, it does create a disk containing the appropriate drivers needed during installation. Navigator supports and runs Microsoft Windows NT, NetWare 3.*x* or 4.*x*, and OS/2, as well as several others. It also provides advice on tuning parameters for maximum performance.

HP NetServer Assistant 2.2, Navigator's OpenView-based management application, monitors and manages the server and other network devices from a single console either locally or remotely. Remote notification is also available with Remote Assistant, a $999 pager module.

The system has a three-year warranty and on-site service.—*PRB*

Hewlett-Packard Co., *Santa Clara, CA; 800-322-4772; fax, 208-344-4809.*

Circle 448 on reader service card

IBM Corp.

IBM PC Server 500

The $22,880 IBM PC Server 500 combines excellent performance, great components, and expandability with comprehensive installation utilities. At the middle to high end of IBM's PC Server line, the single Pentium/90-based PC Server 500 uses IBM's trademark Micro Channel architecture (MCA) bus. Geared as an enterprise server, the unit is flexible enough to adapt to many environments, but we have concerns about the future of the MCA bus.

SUITABILITY TO TASK	IBM PC Server 500
Performance	Excellent
Security/ Fault tolerance	Good
Expandability/ Scalability	Excellent
Server management	Good

IBM also offers the new high-end PC Server 720, which supports two CPUs and has combination PCI/MCA slots. As an entry-level enterprise server, IBM offers the PC Server 320, with dual-processing capability and a combination EISA/PCI bus. IBM's PC Server 300 is a single-processor workgroup server, which utilizes a combination EISA/PCI architecture but lacks management software.

The PC Server 500's throughput placed it near the top of the group—right between the DFI and Digital Equipment Corp. units. Its Fast/Wide disks and controllers undoubtedly helped its performance. It also had low CPU utilization.

One minor flaw in the unit's design is disk-drive accessibility. To gain access to the unit's 22 drive bays—the most of any system in this roundup—you must remove the front cover completely. After that is

removed, access to the drive bays is easy. Although the tested system supplied a single backplane that supports six hot-swappable drives, two additional backplanes can be installed ($239 each) as your server's storage requirements increase. A second power supply can be added as well. IBM simplifies this by offering an optional power supply ($429) that interlocks with the system's existing power unit.

Interestingly, the unit's caddyless CD-ROM drive lies vertically in its tower case. Though workable, this makes installing and removing CDs a cumbersome and somewhat unnatural task.

IBM's ServerGuide software provides easy NOS installation and assists in tuning for particular uses.

The unit used four of eight MCA slots for its IBM NICs. For about as much as this setup, users can buy IBM's recently introduced Quad PeerMaster Ethernet adapter, which will only occupy one slot.

IBM offers ServerGuide with its PC Servers. It is a bootable CD, comparable to Compaq's SmartStart, that provides easy installation of network operating systems: NetWare 3.12 or 4.02 or IBM OS/2 2.11, as well as NetFinity 2.01, IBM's server management software. Because there are many uses for a server, ServerGuide also assists you in tuning your server for optimal performance as an application or database server, file server, multimedia server, or general-purpose server. IBM offers clear documentation in several manuals and in the ServerGuide.

IBM NetFinity 2.01 requires OS/2, has all the standard server-monitoring features, and allows full workstation monitoring. It also offers local and remote notification, as well as remote log-on and diagnostics.—*PRB*

IBM Corp., *Somers, NY; 800-772-2227; fax, 800-426-3395.*

Circle 449 on reader service card

National MicroComputers

NMC Expert Server

The $9,556 Expert Server from National MicroComputers is a no-frills server that offers a solid set of features at a low price. It even incorporates redundant power supplies to provide a measure of fault tolerance, although more-mainstream features such as hot-swappable hard disks are not provided.

SUITABILITY TO TASK	NMC Expert Server
Performance	Fair
Security/ Fault tolerance	Good
Expandability/ Scalability	Fair
Server management	Poor

National MicroComputers will preload NetWare for its customers, but the tunings it chose for our NetBench tests resulted in poor performance. The Expert Server's throughput placed in the lower tier of machines that we tested, and the unit's CPU utilization under moderate and heavy loads was high. With 60 workstations, CPU utilization reached nearly 90 percent.

When we fine tuned the Expert Server for NetBench, though, its throughput was comparable with that of this roundup's best. Credit goes to the system's four 1GB Fast/Wide SCSI-2 hard disks and Adaptec Fast/Wide SCSI-2 controller, and its Cogent four-port Ethernet NIC.

The Expert Server's expandability was fair. It had three EISA slots, three PCI slots, and a shared EISA/PCI slot plus nine drive bays (although only two were available in the tested configuration). Where the Expert Server falls short is server management capabilities. It came with no notable server-specific documentation—in fact, its documentation was essentially just a collection of component manuals, much as you would find in any desktop system, and without the specialized setup or troubleshooting tips that many of the reviewed servers provide. Server management software was also lacking (although a 100-node version of Intel's LANDesk Manager is available for $3,200).

The company offers a three-year warranty on parts and labor. On-site service is an additional $39 for one year.—*WPF*

National MicroComputers, *Murray, UT; 800-800-4662, 801-265-3700; fax, 801-265-3783.*

Circle 450 on reader service card

Polywell Computers Inc.

Poly 500D2

The 100-MHz Pentium-based Poly 500D2 from Polywell Computers is attractive because of its well-chosen hardware and its $11,000 estimated street price. Its combination ISA/PCI-bus motherboard, however, hints that this system's lineage can be traced to the desktop, not the server closet. If you expect to find a full-fledged departmental server here,

Just'N'Case SMP 100, NMC Expert Server, Poly 500D2.

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(see below)

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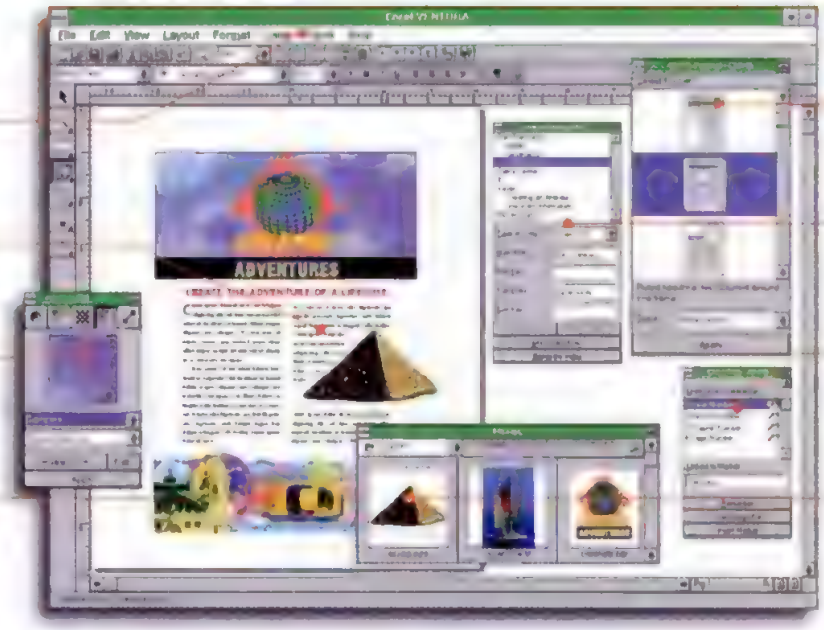

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Product 3.5" disk version	S.L.P. (US$)	Score
Corel VENTURA 5	$595	6.8
QuarkXPress	$895	6.7
Aldus PageMaker	$895	6.2

InfoWorld, Report Card Rating March 20, '95

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you'll be disappointed.

The Poly 500D2's performance was average and improved substantially when we retuned NetWare parameters. As shipped to us for testing, the Poly 500D2 placed among the middle tier of systems. It posted average throughput scores with slightly above-average CPU utilization.

We were able to boost throughput by retuning NetWare in a way that better optimizes its performance on our NetBench tests. The improvement in performance—enough to make the Polywell system competitive with the leaders in this roundup—is testament to a fast hard-disk subsystem. The Poly 500D2 used a Mylex Fast/Wide SCSI-2 disk controller card with 4MB of cache in conjunction with three Seagate 1GB Fast/Wide hard disks. (The system had a fourth, 80MB hard disk that contained the bootable partition.) The Poly 500D2 provided Ethernet support with a Znyx EtherArray four-port card.

SUITABILITY TO TASK	
Poly 500D2	
Performance	Good
Security/ Fault tolerance	Fair
Expandability/ Scalability	Fair
Server management	Poor

The Poly 500D2 offers plenty of expansion room for additional mass-storage devices—ten drive bays in all. The system doesn't support hot-swapping, however. The motherboard offers an empty ZIF socket to accommodate a second CPU (although NetWare doesn't currently support multiprocessing). Polywell provides minimal security and fault-tolerance features; nothing on the system is lockable except for the keyboard.

You can't expect a lot of hand-holding from this machine. Its server-specific documentation was sparse, and though Polywell offers Intel's $1,250 LANDesk Manager, it was not sent with the unit.

Polywell backs the Poly 500D2 with a five-year parts-and-labor warranty. On-site service (with a 6-hour response time) will cost you an additional $200 per year.—*WPF*

Polywell Computers Inc., *South San Francisco, CA; 800-999-1278, 415-583-7222; fax, 415-583-1974.*

Circle 451 on reader service card

Tangent Computer Inc.

Just'N'Case SMP 100

The main advantages of the $12,990 Tangent Just'N'Case SMP 100 are security and fault tolerance. Its performance was average and its design, though not as innovative as some in this roundup, was good. Its components were well chosen, which became apparent after NetWare tuning produced a dramatic increase in throughput. Tangent offers a variety of server configurations, including rack-mount servers.

The huge, wheeled case's size is not indicative of what's inside: The interior space was limited to eight drive bays. Each drive has an individual key lock and these locks, along with the power and reset buttons, are protected by a lockable door to avoid accidental or vindictive loss of power or information. Though the drive chassis allows hot-swapping, the disk controller does not support hardware RAID. Tangent also includes a redundant power supply with its system.

As its name implies, the Just'N'Case's motherboard has room for two processors, though only one has the benefit of a ZIF socket.

The system's performance on our benchmark tests was average. Its throughput placed it among the middle tier of tested systems, but the unit's CPU utilization was among the highest.

SUITABILITY TO TASK	
Just'N'Case SMP 100	
Performance	Good
Security/ Fault tolerance	Excellent
Expandability/ Scalability	Good
Server management	Good

After PC Labs optimized NetWare parameters to run NetBench, however, we found that the Tangent unit had the throughput to compete with entries from Compaq Computer Corp., DFI, Digital Equipment Corp., Hewlett-Packard Co., and IBM. Its Cogent EM964 PCI TP Quartet NIC with a Digital chip set and Adaptec Fast SCSI-2 controller no doubt contributed to the unit's top-notch performance. Its CPU utilization remained high, though.

Documentation included component manuals and a separate binder specifically outlining the server itself with chapters on configurations, fault tolerance, upgrading, and troubleshooting.

Intel LANDesk Manager was the server management package included with the system. It can handle simple network-administration tasks such as accessing the server from any networked computer; monitoring packet rates, utilization, and error levels; taking inventory of hardware and software; and scanning and cleaning for viruses. With optional pager or modem modules, each available in slightly different configurations, remote notification is also available.

Tangent backs its system with a three-year warranty on parts but only one year on labor; on-site service costs an additional $295 per year. —*WPF*

Tangent Computer Inc., *Burlingame, CA; 800-800-5550, 415-342-9388; fax, 415-342-9380.*

Circle 452 on reader service card

Unisys Corp.

Unisys SME 510010

The Unisys SME 510010 came in a large case with lots of expansion room for devices, adapters, processors, and memory. But the $20,307 (list) unit also turned in below-average test results and has a proprietary design that cannot take advantage of PCI technology. There are other reviewed systems from companies such as Digital Equipment Corp. and Hewlett-Packard Co. that are designed with a more open eye toward the future and whose performance eclipses that of the SME 510010.

The SME 510010 has 13 externally accessible drive bays, but its hard disks are not hot-swappable. There are six EISA slots, three others with VL-Bus extensions, and one with an extension strictly for the disk and I/O controller. There are also five other proprietary slots: four for CPU cards and the last for a memory card, which can expand memory to 1GB. Despite these growth options, with the trend in networking going toward PCI, Unisys's reliance on the VL-Bus limits this unit's potential. The company says it will offer PCI-based systems later this year.

There are also two power supplies in the system but they are not redundant. A 350-watt supply powers the electronic logic, such as the slots and motherboard, and a 300W supply handles all power to the drives and other peripherals.

The SME 510010's performance didn't

reach levels that we consider appropriate for a server in this class—only about half the throughput of the leaders. That placed it in the bottom tier of tested systems; its CPU utilization was also among the highest overall. Even after PC Labs optimized NetWare for NetBench, its performance was still among this group's worst.

VisiSoft VisiNet, a server management software package, was included with the SME 510010. It has adequate management utilities to show you what's on your network and handle fault tracking, for example, and includes remote notification via electronic mail.

SUITABILITY TO TASK	Unisys SME 510010
Performance	Fair
Security/ Fault tolerance	Good
Expandability/ Scalability	Good
Server management	Good

The system has a three-year parts-and-labor warranty with on-site service included for the duration.—*WPF*

Unisys Corp., *San Jose, CA; 800-448-1424, 716-292-0880; fax, 716-292-6671.*

Circle 453 on reader service card

Zenith Data Systems

ZDS Z-Server WG5

The ZDS Z-Server WG5—the high-end server ($15,636 list, $13,500 street) from Zenith Data Systems—fails to stand out in terms of performance, expandability, or price. The system's chassis design is complicated, which makes internal access difficult. Also, the server does not come with management software to simplify administration (although ZDS reports that server management software will be available this summer). ZDS also offers the Z-Server WG4 line, which has a single or a dual 486 processor system, and the Z-Server EX line, which consists of entry-level single-processor models.

SUITABILITY TO TASK	ZDS Z-Server WG5
Performance	Fair
Security/ Fault tolerance	Fair
Expandability/ Scalability	Fair
Server management	Poor

On our tests, the Z-Server WG5's throughput came in near the bottom of the group, and it showed high CPU utilization. Although its throughput did increase by about 35 percent after PC Labs retuned NetWare, other machines improved even more, leaving the ZDS unit in last place. Its CPU utilization remained high even in the retuned configuration.

The Z-Server WG5 used four Eagle NE3200 NICs, a configuration that's less efficient than the quad Ethernet PCI NICs used by the leaders in this roundup. It also used four Fast—but not Wide—SCSI-2 hard disks driven by an integrated SCSI-2 controller.

The Z-Server WG5 provides multiprocessing support with a second CPU socket located on the motherboard. The system offers a total of seven drive bays; its hard disks are not hot-swappable. To gain access to the drive bays you must remove the side cover. Within the case is a piece of sheet metal that covers all of the I/O slots—requiring you to remove another set of screws. One other drawback here is the case's single fan: If you lose it, you lose all forced airflow and risk overheating. Given this single point of failure, you might expect to see a thermal sensor. But no server management software or hardware is currently included.

ZDS offers a three-year warranty, with all three years on-site.—*PRB* □

Zenith Data Systems, *Buffalo Grove, IL; 800-582-0524; fax, 800-472-7211.*

Circle 454 on reader service card

Unisys SME 510010, ZDS Z-Server WG5.

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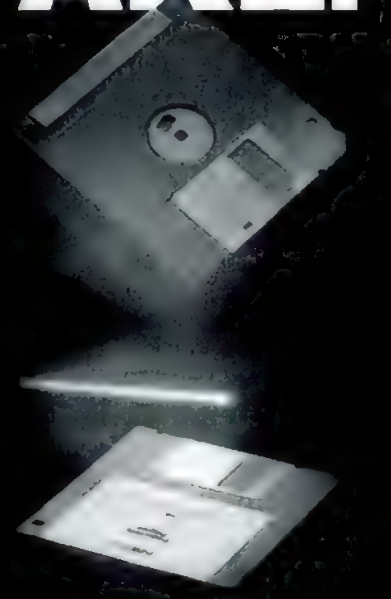

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ULTRAFAST GRAPHICS: *The Professional's Choice*

There's more than magic in these 16 high-end graphics cards. With lightning-fast accelerators and slick utilities, they're perfect for graphics professionals.

By Jeff Mace

Graphics professionals are a needy bunch—at least when it comes to their workstations. Photoillustrators and page-layout professionals, whose work is mainly raster-based, demand every bit of pixel-pumping bandwidth they can get. Those who use vector-intensive illustration tools and CAD/CAM packages need lightning-fast screen draws and powerful

Illustration by Janet Woodley

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hardware-based vector support. These pros are likely to own powerful PCs with lots of RAM, huge hard disks, and high-performance monitors. But the peripheral they depend on most for speed and color integrity is the graphics adapter.

We looked at accelerated graphics cards created for the graphic designer, the color-production specialist, and the CAD/CAM engineer. We also looked at a host of top-flight cards that are mostly limited to 4MB of video memory (VRAM) and deliver lower resolutions but that still impressed us with stable drivers, blazing speeds, slick utilities, and cost-effectiveness.

WHAT WE TESTED

To qualify for inclusion in this evaluation, cards had to be configured with at least 4MB of RAM, designed to connect to a PCI bus interface, and able to achieve a resolution of 1,600 by 1,200 pixels in at least 16-bit color. They also had to be capable of displaying 24-bit color in at least 1,024-by-768 resolution. We included only products that were commercially available by the time our testing began.

Our search turned up 16 cards ranging in price from the $439 Cardex Genesis from Cardexpert Technology to the full-featured, $1,999 #9 Imagine128 Pro 8MB from Number Nine Visual Technology Corp. The lineup includes two triple-controller designs: rPC's FireStorm 192 and UMAX's Maxmedia CX/Pro. Two cards, Matrox's new MGA Millennium and the #9 Imagine128 Pro 8MB, were equipped with 8MB of VRAM. One impressive-looking new offering, ATI's Graphics Pro Turbo 1600, was not shipping in time for our testing and is covered in a sidebar.

MORE THAN JUST SPEED

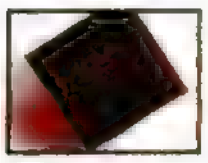
Though raw speed is a must, it isn't everything. In addition to comprehensive benchmark testing in Microsoft Windows and AutoCAD Release 12, we examined everything from ease of installation to color calibration, refresh-rate tuning, zoom and pan utilities, and other niceties like virtual-desktop management and on-the-fly resolution switching. We also took an exhaustive look at each card's Windows drivers. (For details of our testing methodology, see "Performance Tests: High-End Graphics Cards.") Of course, Windows isn't the only operating system out there. We tallied the available drivers for Microsoft Windows NT and IBM's

The Components Behind the Cards

High-End Graphics Controllers

ATI Technologies Inc.
ATI mach64

ATI offers its home-grown graphics controller in VRAM and DRAM versions. This chip typically places among the top-tier performers. The 64-bit design accelerates most Windows graphics calls, has numerous built-in capabilities for optimizing 24-bit raster operations, and provides a direct interface to the company's SpectraDAC.



Matrox Graphics Inc.
MGA 64-bit
MGA-2064W

The chip everyone wants to beat, Matrox's MGA, was the first of the 64-bit graphics controllers. The newer MGA-2064W is a WRAM version of last year's MGA 64-bit. Both MGA chips not only provide Windows acceleration but include built-in 3-D acceleration with Garound shading and Z-buffer support. The 2064W also offers video acceleration.

Number Nine Visual Technology Corp.
#9 Imagine128

The #9 Imagine128, the only 128-bit graphics engine available today, delivers ultrahigh bandwidth thanks to simultaneous processing of four true-color data streams per clock cycle. Its blazing speed also comes from its ability to maintain a 128-bit data path to video memory. The Imagine128 requires a minimum of a 4MB frame buffer.

S3 Inc.
S3 Vision 864
S3 Vision 964
S3 Vision 968

S3's Vision family is one of the most popular today, thanks to its speed, stability, and high-quality driver sets. The majority of cards in this story use S3-based designs. The current chips are second-generation releases of S3's 64-bit Vision 64 family. The newest family member, the Vision 968, offers a top-flight graphics engine and integrated video scaling and acceleration.

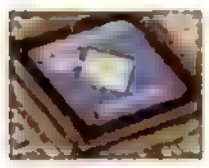
Weitek Corp.
Weitek Power 9100

With a 64-bit design, the Weitek Power 9100 is an aging accelerator that delivers lackluster performance. A year and a half ago, it was one of the fastest chips we saw. The Power 9100 is mostly found in conjunction with Weitek's Video Power video coprocessor, arguably the best *x, y*-scaling engine around.

High-End RAMDACs

ATI Technologies Inc.
ATI SpectraDAC

The ATI SpectraDAC interfaces directly with the company's mach64 accelerator. The 220-MHz version is able to provide a VESA-compliant 75-Hz refresh rate at 1,600-by-1,200 resolution with 16-bit color. The SpectraDAC offers a direct 64-bit interface to VRAM.



IBM Corp.
IBM RGB514
IBM RGB524
IBM RGB525
IBM RGB528

IBM is one of the largest RAMDAC suppliers. Its 64-bit RGB524 and RGB525 and 128-bit RGB528 are high-performance parts available at clock speeds of up to 250 MHz. The 220-MHz version of the RGB524, the fastest in our roundup, delivers refresh rates of up to 80 Hz at 1,600-by-1,280. The RGB514 is a lower-performance part used in price-sensitive applications.

Texas Instruments Inc.
TI PTVP3024
TI PTVP3025
TI PTVP3026

Used interchangeably with the IBM RGB524 or RGB525, the top-of-the-line PTVP3026 runs at 220 MHz, a must for driving ultra-high-end 21-inch monitors at noninterlaced vertical refresh rates of over 100 Hz. Competitively priced, TI RAMDACs are some of the most popular among high-end card manufacturers.

OS/2 Warp and previewed drivers for Windows 95 (for details, see the sidebar "Test-Driving 32-Bit Drivers").

Many products also provided well-designed DOS AutoCAD DLDs (display list drivers), which add features to the DOS interface like a GUI text window, point-and-click dialog boxes, and bird's-eye zoom.

Among the most important factors differentiating professional-level cards are their built-in color-calibration tools. These let you adjust the color-signal output from the RAMDAC (RAM digital-to-analog converter) to the screen. Improperly calibrated systems can cause disasters: Graphics designers have long been aware of the danger of designing in one color on the screen and winding up with another in print. Color calibration comprises controls for performing gamma correction for varying ambient lighting levels and coordinating color synchronization between the card's RAMDAC and the monitor's RGB (red, green, blue) guns.

Another feature that sets professional graphics adapters apart is support for ultrahigh vertical refresh rates—those in excess of 80 Hz. Though higher than VESA's recommended minimum of 75 Hz, ultrahigh refresh can be a significant ergonomic factor when using the latest 21-inch monitors. Only 2 of the 16 cards we evaluated could drive a monitor in excess of the VESA spec at 1,600-by-1,200 resolution; 11 could at 1,280-by-1,024. Key to this ability is the clock speed of the card's RAMDAC, which varied from a placid 175 MHz to a screaming 220 MHz.

For graphics professionals:

• #9 Imagine128 Pro 8MB

For high-end business workstations:

• Diamond Stealth 64 Video VRAM

With a bevy of features squarely targeted at the color-production specialist, the raw horsepower to deliver blazing pixel throughput, and the muscle to drive 21-inch monitors at ultrahigh refresh rates, two cards emerged as clear Editors' Choices: The #9 Imagine128 Pro 8MB from Number Nine Visual Technology Corp. and the Stealth 64 Video VRAM from Diamond Multimedia Systems.

The Imagine128 Pro 8MB uses very every bit of power to process graphics data and blast it to the screen at some of the fastest rates we've ever seen. The card's impressive consistency of performance across more than 200 tests highlights its extremely stable, highly optimized driver and well-engineered hardware timing functions. Its Color Perfect color-calibration and gamma-correction tool is the highlight of its impressive HawkEye utilities set.

The Stealth 64 offers an excellent cost-effective solution for the high-end business PC that doubles as a graphics workstation. Its S3 Vision 968–based design and stable drivers delivered consistently strong performance on our benchmark tests. The well-honed InControl utilities set and a generous software bundle round out this attractive offering.

An honorable mention goes to rPC's FireStorm 192, an intriguing card that harnesses three S3 Vision 864 graphics controllers to deliver a 192-bit data path for blasting out true-color data. Though a design this expensive would be overkill for mainstream work, it's a lifesaver for graphics applications that move huge amounts of data.

BREAKING BOTTLENECKS

There is always room in the market for innovative approaches to preventing the bottlenecks caused by graphics applications. This year saw no shortage of new angles on controller and card design. New are the Imagine128 chip from Number Nine, featured on an 8MB and 4MB card from that vendor. The Imagine128 boasts a 128-pin hardwired pathway to the VRAM and the RAMDAC. This solution, akin to a 128-lane highway, offers some of the highest transfer rates we've ever measured.

New designs from S3 also made an appearance. The second-generation S3 Vision 968 chip offers integrated digital video acceleration and scaling in its powerful 64-bit VRAM controller. The chip supports up to 8MB of VRAM for rendering 24-bit color at 1,600-by-1,200 resolution. Unfortunately, the cards in this evaluation based on this chip were only configured with 4MB of VRAM. The S3 Vision 864, a DRAM version of the Vision 964 VRAM graphics controller, makes its appearance in extraordinary three-chip implementations from rPC and UMAX Technologies. In these designs, each chip has its own 2MB DRAM frame buffer dedicated to the red, green, or blue channel. The total data path for true color is 192 bits wide.

The MGA-2064W, a new chip from graphics veteran Matrox, includes 3-D and digital video acceleration. For details on this and other chips with video support, see the sidebar "Accelerated Video: Now Premiering."

All of the cards here except the three-chip designs use some form of dual-ported VRAM. Several use the much-talked-about EDO (extended data out) VRAM to increase pixel throughput to about 30 percent. For a look at this and other new RAM technologies, see the sidebar "Video Memory: The Latest Chips."

Whether you need raster power, vector intelligence, or refresh speed, the information presented on the following pages can help you find the right solution.

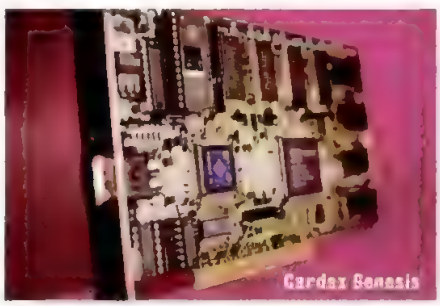
Our Contributors: JOHN R. QUAIN is a contributing editor of *PC Magazine*. JONATHAN HILL, JAMES KARNEY, and JAN OZER are frequent contributors to *PC Magazine*. DAVID A. HARVEY is a freelance writer based in Philadelphia. THOMAS MACE was the associate editor in charge of this story, and JEFF MACE was the project leader.

Cardexpert Technology Inc.

Cardex Genesis

BY JONATHAN HILL

Cardexpert Technology's Cardex Genesis ($439) is a bare-bones OEM product targeted primarily at systems vendors. Though this 4MB VRAM-based card can provide an acceptable low-cost solution for applications where performance is not critical, its lack of creature comforts reminds us just how much we've come to expect from graphics accelerators.


Cardex Genesis

The S3 Vision 964–based Genesis ships with generic Windows and AutoCAD drivers supplied by S3. Cardexpert makes no pretense of relabeling the S3 driver disks with its own stickers, and it provides a generic S3 Vision 964 installation manual in lieu of its own. In fact, the only place the Cardexpert name appears is on the outside of the box. Purchasers will be hard-pressed to find product and technical-support information. A company spokesperson told us that information is available within a README file, but we couldn't find it.

A combination of DOS-based installation routines and Windows' own setup procedure will get you up and running. To set the refresh rates for each graphics mode, you use a DOS-mode utility and modify some command line switches that run from AUTOEXEC.BAT. The utility's not very elegant, and you must leave Windows to change parameters, but it works.

Unfortunately, the Genesis tops out at a vertical refresh rate of 75 Hz at 1,024-by-768 resolution in 24-bit true-color mode; it offers only 60 Hz at 1,600-by-1,200 resolution in 16-bit color mode. VESA's recommended minimum refresh rate at that resolution is 75 Hz; almost all of the other cards in this evaluation are able to exceed this value at this resolution. Many people find a 21-inch monitor to be nearly unusable with a vertical refresh rate of 60 Hz and resolution of 1,600 by 1,200 pixels.

In spite of these failings, the Genesis performed acceptably on some of our benchmark tests, a testament to the efficacy of S3's Vision 964 driver package. Though its Graphics WinMark 95 scores place it among the slowest cards here, its Winstone 95 results were only slightly slower than similarly configured S3-based cards from ELSA, Hercules, and Number Nine that define the middle of the pack.

The Genesis's IBM RGB525 RAMDAC provides adequate refresh support up to 1,024-by-768 resolution in true color but pales in comparison to other cards that can maintain a rock-steady display in 1,600-by-1,200 true-color mode.

MISSING CREATURE COMFORTS

S3 typically provides prospective card vendors with a reference card design, an accelerator chip set, and a working driver set. These packages are typically of such good quality that even a large card vendor with its own in-house driver development team may achieve only marginally better performance than the generic offering. To add value, many big card vendors have turned to developing productivity-enhancing utilities that provide niceties like virtual displays, pans, zooms, color calibration, and other features pertinent to high-end users. Many midsize firms (and some larger ones) bundle these utilities from developers like Binar Graphics.

Cardexpert has opted out of this arena, however; there are few creature comforts. If you don't have a large high-bandwidth monitor and can find the Genesis at a reasonable price, you can purchase standalone third-party utilities to beef up the card's features. We successfully used Binar's AnyView Professional ($49.95) with the Genesis for color calibration, resolution switching, bird's-eye zoom, and virtual desktops. The AnyView utilities are no substitute for a tightly integrated

SUITABILITY TO TASK

Cardex Genesis

Raster graphics	Fair
Vector graphics	Good
CAD	Fair
Mainstream usability	Fair

Suitability to Task: High-End Graphics Cards

A Pentium PC coupled with a high-resolution, high-refresh 21-inch monitor adds up to a formidable graphics platform. To match its capabilities, high-end graphics cards need blazing hardware acceleration, highly tuned drivers, and sophisticated utilities. We rate 16 cards according to four professional tasks.

To score well on **raster graphics,** a card must color-calibrate its output, perform gamma correction for varying lighting conditions, and accelerate a variety of BitBlt operations. Higher true-color resolutions and fast refresh rates appropriate for high-end 21-inch monitors figure into the evaluation. Support for external color-calibration devices earns extra points.

To receive a rating on our **vector graphics** task, a card must have drivers that interpret the wide variety of Windows GDI calls making up the spectrum of vector operations, including the more esoteric operations found only in vector functions. To score well, the product must provide useful features for graphics artists, such as a virtual desktop with hardware pan and zoom. We also consider font caching and rendering routines. These features are especially useful for DTP work involving complex text treatments and graphics.

SUITABILITY TO TASK

Product Name

Raster graphics	Excellent
Vector graphics	Good
CAD	N/A
Mainstream usability	Poor

N/A Not Applicable: The Product does not have AutoCAD drivers

To receive a rating for our **CAD** task, the card must ship with AutoCAD drivers. (Products without AutoCAD drivers receive an N/A.) We look at each card's ability to accelerate normal CAD operations, including text zoom, redraw, and pan and zoom in 2-D and 3-D. We also look for extensions to the AutoCAD environment, such as bird's-eye zoom, scrollable text boxes, and palette handling. Cards that manage the display list poorly or leave remnant pixels on the screen after a move or regeneration receive low scores.

Our **mainstream usability** score is derived from the ease of installation, stability of the drivers, and value and usability of add-ons. To score well, a product must install without a hitch and should include thorough documentation. Higher ratings go to products that provide Display Data Channel (DDC) support or preset modes for a variety of monitors, automatic or selectable refresh rates, a user-definable setting for fixed-frequency monitors, and software-programmable settings in nonvolatile memory. Cards that leave artifacts while running Windows with a normal application load receive our lowest rating.

THE COLD
HARD FACTS
GATEWAY2000
GATEWAY2000
LIBERTY

F10
Pause
Break
Prt Sc
Sys Rq
Ins
Del
BkSp
Enter
Shift
PgUp
PgDn
intel
inside

CLEAR-CUT ANSWERS

Your choice of a portable PC may not seem like a crystal clear decision at first. There are about a gazillion portables to choose from. Want some clear-cut answers to what's right for you?

Gateway 2000® offers quality portables with performance and features that'll thrill you to chills. But whether or not a Gateway Liberty™ or ColorBook²™ portable PC is the right choice for you, look at these guidelines before choosing your portable PC.

Processor

You'll need a 486DX2 processor at the very minimum. We strongly recommend a DX4. Spreadsheets, graphics and word processing all run better and faster with the DX4 processor. All Gateway 2000 portable PCs include a DX2 or DX4 processor.

Cache

Cache is great — that is when you can find it on a portable — because it gives you a superior performance. Our Liberty DX4-100 includes 256K L2 cache on an accelerated local bus yielding Pentium™-like performance. The ColorBook² includes 512K video cache for great video performance.

Hard Drive

Nothing less than a removable 340MB hard drive will do. In fact, you'll want the largest hard drive you can get. Microsoft® Windows,™ DOS® and standard software applications automatically consume around 140MB at the time of purchase. All Liberty and ColorBook² PCs include at least a 340MB removable hard drive. The Liberty DX4-100 Best Buy and ColorBook² DX4-100 Best Buy both include a 720MB removable hard drive.

RAM (Random Access Memory)

A bare *minimum* of 8MB RAM is best — 4MB wasn't enough last year. To run Windows (*and* Windows 95) you'll need 8MB. 8MB will also increase your battery life and improve system performance. All Liberty and ColorBook² systems come standard with 8MB RAM and are expandable to 20MB or 24MB RAM.

Screen

When you're talking portables, you want the biggest, clearest display possible without adding weight or hiking up the price.

A good way to judge screens is to divide the screen size of the portable by its weight. The higher the ratio the better. The Liberty has an incomparable screen size-to-weight ratio of 2.44. This 10.4-inch screen also gives you 23 percent more active viewing area than a 9.4-inch screen and 53 percent more than an 8.4-inch screen.

The Liberty's 10.4-inch and ColorBook²'s 10.3-inch screens give you the best value available in a color display. With vivid colors and bright, clear screens, you'll forget you're working on a portable PC.

Size and Weight

It's a portable PC — the smaller and the less it weighs, the better! The Liberty and ColorBook² emerge favorably in both areas.

Batteries

Look for between three and four hours of battery life depending on the processor and RAM. Batteries based on nickel metal-hydride (NiMH) or lithium ion will give you the best performance. The Liberty gives you up to four hours or more with power management. And it also allows for upgrading to a lithium ion battery.

Software

The better the included software applications, the more the value of your portable PC increases. Pre-installed on all Gateway portables is Microsoft Works for Windows 3.0 or MS Office Professional 4.3. The OAG® FlightDisk® and World Clock software is also included on all Gateway portables.

Keyboard & Pointing Device

You'll need a keyboard that's comfortable for you and that's also easy to use. The Liberty is equipped with a large palm rest, and flip-out feet so you can adjust the keyboard angle.

Pointing devices vary greatly. Again, find one that's easy for you to work with. Gateway's EZ Point™ integrated pointer is uniquely positioned to be comfortable and easily accessible.

Infrared Technology (IR)

Extras such as the Liberty's IR technology add even more value to your portable PC. With it you can take advantage of wireless file transfer — this means transferring files between the Liberty and your desktop (or between two Liberty PCs) without cables!

Service

You'll want to make sure you have the right support for your portable PC. When you buy from Gateway 2000, you have dedicated portables technical support for the life of your Gateway system. These technicians are trained to specifically handle all your portable questions and concerns. We also offer a special VIP warranty.

Now that you have all the facts, go ahead and shop around. Then call one of our friendly sales representatives about the very cool Liberty and ColorBook² portable PCs from Gateway 2000.

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hardware/software set such as Number Nine's HawkEye or Diamond's InControl, but they go a long way toward making the Genesis a viable, low-cost option.

Cardex Genesis. *List price: $439. Cardexpert Technology Inc., 47881 Fremont Blvd., Fremont, CA 94538; 510-252-1118; fax, 510-252-9889.*

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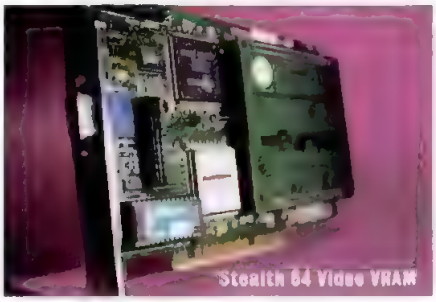
Diamond Multimedia Systems Inc.

Stealth 64 Video VRAM

BY JAMES KARNEY

PC MAGAZINE EDITORS' CHOICE

The Stealth 64 Video VRAM, the top of the line in Diamond's Stealth family of graphics adapters, is the company's offering aimed at serious graphics users. Based on the S3 Vision 968 graphics controller, the $559 PCI card we tested (a VL-Bus version is also available) sports 4MB of VRAM and a 220-MHz Texas Instruments RAMDAC that can drive a 1,600-by-1,200 screen in 16-bit color at a 76-MHz refresh rate. This is clearly not a premier card for graphics professionals, but given its strong overall performance and the amount of software included, the Stealth 64 adds up to a solidly performing bargain.


Stealth 64 Video VRAM

The Stealth 64 fared quite well on our Graphics WinMark 95, Raster Rotate, and Vector File Open tests, where it was frequently the front-runner among the six S3 Vision 968–based cards we reviewed. On our Winstone 95 tests, it turned in the second-best score we saw. Overall, performance was clean and snappy.

AutoCAD and MicroStation operation is provided by Panacea's TurboDLD Deluxe, Version 2.1, and panaStation Classic drivers. This hardware/driver combination won't be an out-and-out hit with AutoCAD users, however. The Stealth 64 was one of the slowest performers on our 3-D Pan test, and it landed squarely in the midrange on our Redraw All test.

Installation is straightforward, something you hope for in a PCI graphics adapter. You can run the setup from either DOS or Windows, and we encountered no problems in getting the

Test-Driving 32-Bit Drivers

By James Karney

Microsoft Windows 3.1 may be today's dominant PC operating environment, but it's far from being the only one. Graphics professionals are increasingly turning to 32-bit operating systems such as Microsoft Windows NT and IBM's OS/2 Warp. Improved stability is probably the biggest reason, but better performance on some memory-intensive operations and the availability of new graphics APIs also play a large role.

With Microsoft Windows 95 now firmly on the radar screen, the move to 32-bit environments will soon become a stampede. It's a safe bet that most of the Windows graphics community won't be using Windows 3.1 by this time next year.

WILL IT RUN?

Changing your OS means getting your graphics card to work with the new operating system. The first question to ask is whether drivers are available. Of the cards reviewed in this story, only the Cardex Genesis, the #9 Imagine128 Pro 8MB, and rPC's FireStorm 192 did not include drivers for either OS/2 or Windows NT. The MGA Millennium did not include OS/2 drivers, while the #9FX Motion771 and the #9GXE64 Pro 1600 PCI did not provide drivers for Windows NT.

But driver availability is only the beginning of the story. You need to know the stability of the driver, how easy is it to install, and whether it supports the same feature set as its Windows 3.*x* counterpart. This is an area where much improvement is needed. None of the 32-bit drivers we looked at provided the same level of user enhancements found in their Windows 3.*x* versions.

For example, to use the MGA Impression Plus in Windows NT, we first had to install Windows 3.1 and set up the card to get the proper monitor adjustments. Once armed with those numbers, we found that basic Windows NT driver support was excellent, and we saw very crisp response for both vector and bitmap screen redraws. All of the resolutions available under Windows 3.11 were usable, but switching between them required rebooting.

The Windows 95 Preview Program raises special driver considerations. Rather than rely on graphics vendors directly, Microsoft has supplied a number of generic drivers—including ones for ATI Technologies and Matrox Graphics controllers, as well as for the S3 Vision 964 (but not the Vision 968). The major graphics cards and controllers will undoubtedly have basic Windows 95 support when the final product is released.

We used the ATI and Matrox drivers with the Windows 95 prerelease and found that configuring the adapter was even easier than under Windows 3.1. But feature support was limited. Though we could change the resolution from the Windows 95 Control Panel, there was no provision for mode-switching and image-tuning. Most of the vendors we asked said that full Windows 95 support is on the way, however.

All of the OS/2, Windows NT, and Windows 95 drivers we tried appeared stable, but Windows 3.*x* has clearly absorbed the lion's share of driver development. If you need any advanced driver feature or utility for an alternative OS, you should definitely confirm that it's in the driver before you buy. □

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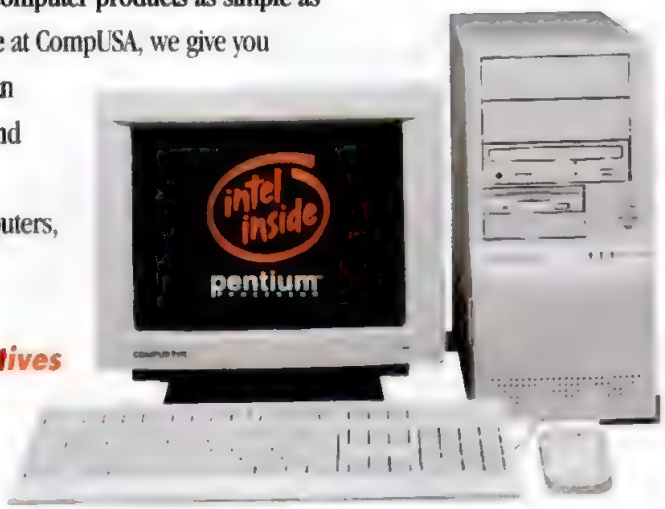

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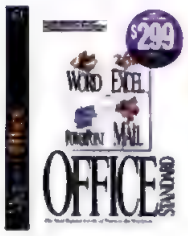

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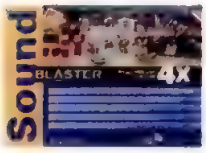

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Video Memory: *The Latest Chips*

By Jonathan Hill

Graphics accelerators have changed drastically over the last few years, but the memory chips that form their backbone have scarcely advanced since the early days of the PC. Standard DRAM (dynamic RAM) has had a long and glorious run, but it is finally hitting insurmountable hurdles.

Memory on a graphics card sits between two harsh taskmasters. At one end, the graphics accelerator chip processes commands from the CPU, converting graphics calls into a data stream to be written into the frame buffer (graphics memory) prior to being sent out to the display. At the other end, the RAMDAC reads the information stored in the frame buffer so that it can update the display.

In a standard DRAM implementation, these two tasks often clash as there is only one "door," or port, into a DRAM chip. At a refresh rate of 75 Hz, the RAMDAC needs to read the contents of the frame buffer 75 times per second. In true-color mode at a resolution of 1,024 by 768 pixels, that's roughly 170MB of graphics data flowing from the frame buffer to the RAMDAC each second—nearly the entire available output from a conventional DRAM design.

Fortunately, a number of enhanced memory designs are waiting in the wings to address the bottleneck. The first major contender, EDO (extended data out) DRAM, is already shipping in a number of graphics products and has begun to appear as a replacement for standard DRAM as well. EDO DRAM improves throughput by allowing valid data to persist through a longer portion of the memory cycle. This lets the chip perform some bookkeeping chores while data is being read, boosting throughput by up to 30 percent. EDO DRAM is compatible with standard DRAM, and its cost is expected to drop to standard DRAM levels. But its performance boost is relatively modest, and it will probably stay at the low end of the market.

DUAL-PORTED DESIGNS

Many high-end cards today use dual-ported memory chips. Dual-ported designs add a second, read-only port to the DRAM's read/write port. This allows the RAMDAC to perform refresh-related tasks with minimal impact on the bandwidth. The most common dual-port design, VRAM (video RAM), has been around for quite some time, but several new types will soon appear.

One, WRAM (Windows RAM), adds two graphics-specific features to VRAM's block-write and page-masking capabilities. Dual-Color Block Write helps the card perform very fast pattern and text fills, while WRAM's native support for aligned BitBlts gives it the ability to perform fast buffer-to-buffer transfers for video and double-buffered 3-D animation. WRAM is about as expensive than VRAM, however, and both are considerably more expensive than conventional DRAM.

A revolutionary enhancement to conventional DRAM from Rambus, a small California-based R&D company, has sparked memory manufacturers' interest. Rambus is a specification for a new bus structure for memory, complete with bus mastering (the Rambus Channel Master) and a new pathway (the Rambus Channel) between memory devices (the Rambus Channel Slaves). A single Rambus Channel has the potential to reach 500MB per second in burst mode.

Other emerging technologies include SDRAM (synchronous DRAM), SGRAM (synchronous graphics RAM), EDRAM (enhanced DRAM), CDRAM (cache DRAM), MDRAM (multibank DRAM), and RAMLink, a nonproprietary interface backed by the IEEE that is similar to the Rambus channel but arranged in a ring topology. Any of these technologies may well impact the graphics market down the road, but only SDRAM is close enough to production to have garnered much industry support. SDRAM incorporates a synchronous clock signal and a two-bank memory architecture to provide peak bandwidths in the range of 500MB per second. □

card up and running.

All adapter functions and monitor adjustments are made through Diamond's InControl Windows utility. Its clear, well-designed interface lets you perform color calibration, define custom monitor settings, control pan and zoom features, and center the display on the screen. The InControl interface also lets you control power-management functions and associate desktop settings with specific applications. A report generator provides basic information about the card and lets you add notes. You can also use InControl to change the desktop viewing size within a virtual desktop, effectively changing the screen resolution on the fly.

SUITABILITY TO TASK

	Stealth 64 Video VRAM
Raster graphics	Good
Vector graphics	Excellent
CAD	Fair
Mainstream usability	Excellent

QUITE A BUNDLE

The card and driver are only part of the story. The horde of applications bundled with the product is the other. The biggest attraction is the pair of CD-ROMs that contain a full copy of CorelDRAW 4.0. With the upgrade coupon in the box and $25, you can even get a set of manuals. Also included on another CD-ROM is a limited OEM copy of Asymetrix's 3D F/X that lets you produce 3-D scenes using a drag-and-drop interface.

To take advantage of the S3 Vision 968's video acceleration, Diamond includes an OEM copy of Asymetrix's Digital Video Producer video editor, as well as a run-time copy of Microsoft Video for Windows. The company plans to release an optional daughterboard later this year that will accelerate video, perform MPEG decompression, and display TV signals from S-Video, PAL, and NTSC sources.

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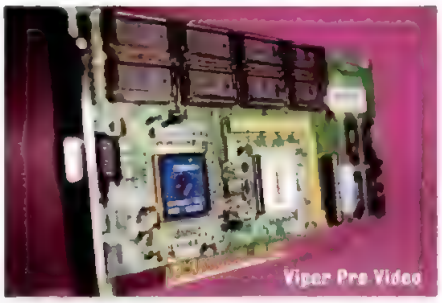
CIRCLE 127 ON READER SERVICE CARD

The Stealth 64 offers a fine solution if you're looking for a high-end Windows business system that can also double as a graphics workstation. The card surprised us with its ability to keep up with much higher-priced products. It lacks some of the power and refinements that are needed for true professional work (such as 24-bit color at 1,600-by-1,200 resolution), but it offers solid performance and a lot of extras in the bundle. Add to that a five-year warranty plan and the ease of use of the InControl interface and it's a great bet as a midrange Windows workhorse.



Stealth 64 Video VRAM. *Estimated street price: $559. Diamond Multimedia Systems Inc., 2880 Junction Ave., San Jose, CA 95134; 800-468-5846, 408-325-7000; fax, 408-325-7070.*

Circle 456 on reader service card

Diamond Multimedia Systems Inc.

Viper Pro Video

BY JAMES KARNEY

When you compare the $649 Viper Pro Video with Diamond's $559 Stealth 64 Video VRAM, you wonder how the Viper Pro is supposed to compete. It seems to lack the horsepower and extras to stay even—much less command a higher price. But Diamond is not positioning this card as a rival Windows graphics accelerator for high-end users. The Viper Pro Video is setting its sights on the multimedia market, and it does a good job of hitting that target.

Powered by a Weitek P9100 accelerator chip, the Viper Pro Video uses a comparatively slow 170-MHz IBM RGB525 RAMDAC that tops out at a placid 66-Hz vertical refresh rate at 1,600-by-1,200 resolution running in 16-bit color mode. At a basic 1,204-by-768 resolution, the refresh jumps to an ergonomic 100 Hz.

The 4MB PCI version we tested was generally lackluster on our benchmark tests, drawing last place on our Raster Rotate, AutoCAD 3-D Pan, and Graphics WinMark 95 tests. Its only decent showings were an above-average Vector File Open result and a midrange AutoCAD Redraw All score. With today's graphics cards, slow is a relative concept—but no one should pick this product based on its speed.

SUITABILITY TO TASK

Viper Pro Video	
Raster graphics	Fair
Vector graphics	Good
CAD	Fair
Mainstream usability	Fair

VIDEO PROWESS

The Viper Pro Video's strength lies in its Weitek P9130 video coprocessor, one of the best architectures available today. On a fast Pentium system, the P9130 is able to accelerate and scale 180-by-240 video up to 1,280-by-1,024 resolution with little or no degradation. The Viper Pro Video supports Cinepak, Indeo 3.2, and Video 1 codecs, and we ran all during testing without a hitch.

You can set up the Viper Pro Video from either DOS or Windows. From that point on, you control all adapter and monitor adjustments from Diamond's impressive InControl set of Windows utilities.

In keeping with Diamond's bundling approach to value-added marketing, the Viper Pro Video comes with an OEM copy of CorelDRAW 3.0 on CD-ROM, a set of video playback goodies from Jasmine Multimedia on a second CD-ROM, and DL-Express CAD drivers. The Viper Pro Video is backed with a five-year warranty and the usual run of technical-support, BBS, and CompuServe forum services. The card is available in both PCI and VL-Bus versions with either 2MB or 4MB of VRAM.

The Viper Pro Video is not an everyday, bread-and-butter card for the serious graphics professional; to be fair, it does not claim to be. If you need a single card that can handle basic Windows tasks, manage average graphics tasks, and really shine when it comes to video playback, the Viper Pro Video is hard to beat. The bundled applications make it very attractive for the newcomer to multimedia who has not yet accumulated a software library.

But those less interested in video who want to boost graphics-intensive applications will discover that there are better buys to be had.

Viper Pro Video. *Estimated street price: $649. Diamond Multimedia Systems Inc., 2880 Junction Ave., San Jose, CA 95134; 800-468-5846, 408-325-7000; fax, 408-325-7070.*

Circle 456 on reader service card

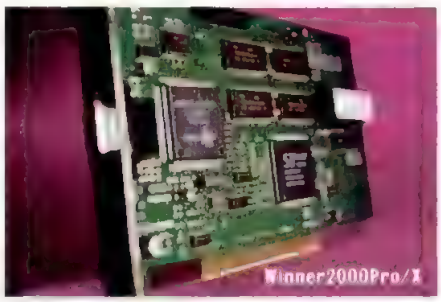
ELSA Inc.

Winner2000Pro/X

BY JONATHAN HILL

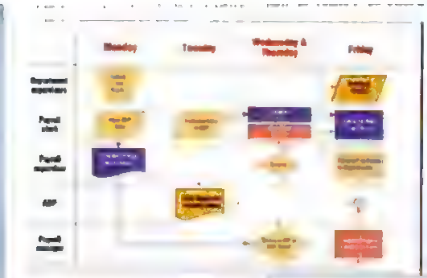
ELSA Inc. is a German-based company that has garnered a well-deserved reputation for CAD-oriented productivity enhancements and nearly incomprehensible installation routines. With the new Winner2000Pro/X ($699), ELSA has improved its installation routines and Windows productivity features, which now rival the best, while maintaining and improving its tradition of excellent CAD support.

The Winner2000Pro/X pairs the S3 Vision 968 graphics/video accelerator chip with a lightning-quick 220 MHz TI PTVP3026 RAMDAC and 4MB of VRAM. This combination results in a fast, stable card that can maintain the high refresh rates necessary to drive the best 21-inch monitors at their peak settings. In true color, the card maintains a refresh rate in excess of 100 Hz at a resolution of 1,024 by 768 pixels and manages to exceed VESA's recommended rate of 75 Hz even at its highest resolution and color depth (1,600 by 1,200 pixels and 16-bit color).

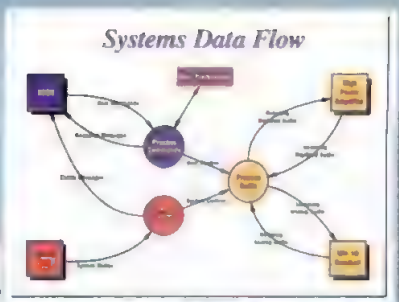


The Winner2000Pro/X installation routine betrays its Germanic origins with bilingual instructions in its opening screen and occasionally obscure syntax in some messages and help files, but this setup is generally unobtrusive.

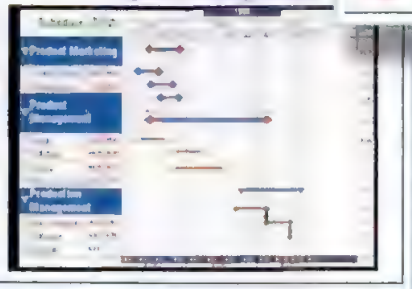
The Windows-based installation is



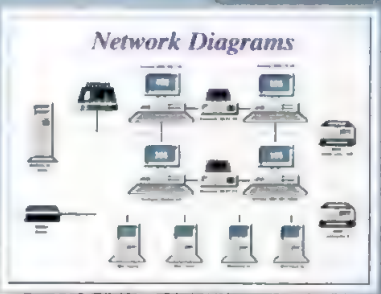
Flowchart



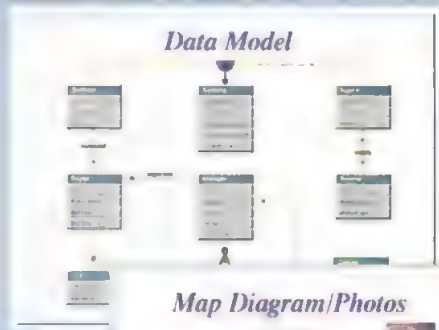
Systems Data Flow



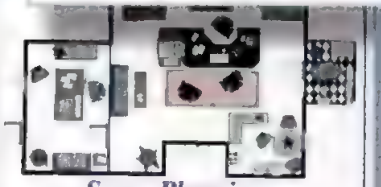
Project Management



Network Diagrams



Data Model



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Map Diagram/Photos

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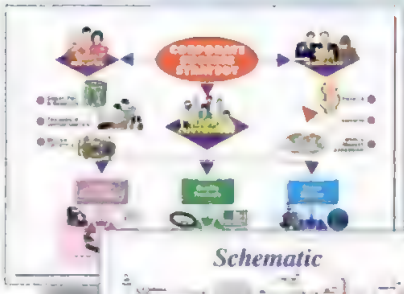

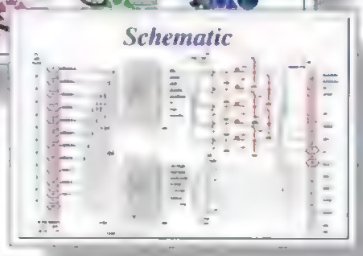

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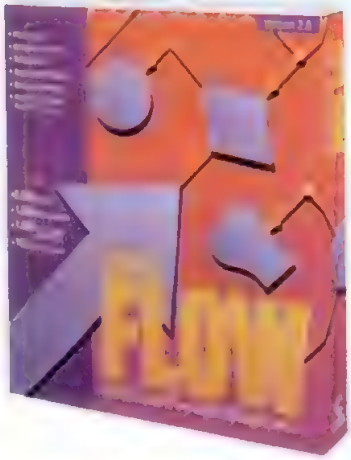

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Document #1054

Preview: *ATI Graphics Pro Turbo 1600*

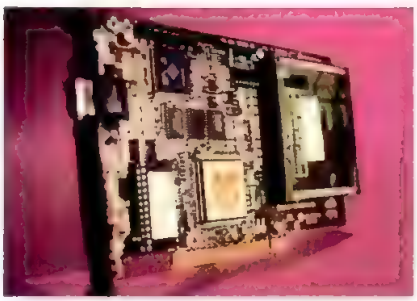
By Jonathan Hill

ATI Technologies was unable to ship the final version of its Graphics Pro Turbo 1600 in time for this roundup, but we tested and evaluated a near-final preproduction model. (The final product is expected to ship by the time this story appears.)

The new Turbo 1600 is a 4MB-VRAM version of the company's Graphics Pro Turbo with a faster, 220-MHz RAMDAC. The combination provides a VESA-compliant 75-Hz refresh rate and 16-bit color up to the card's maximum resolution of 1,600 by 1,200 pixels. Engineered around the ATI mach64 accelerator, the Plug and Play–compliant Turbo 1600 provides a solid feature set and good all-around performance.

The DOS-based installation software works flawlessly but is beginning to show its age. There are very few monitor selections, for example, and not all the models represented are up to date. This is especially curious given that the Turbo 1600 is one of the first Plug and Play–compatible cards to comply with the VESA DDC (Display Data Channel) standard—giving it the ability to configure itself automatically with Plug and Play–compatible, DDC-compliant monitors.

Once the Turbo 1600 is installed, its Windows features are accessible from the ATI Desktop control utility. In addition to standard enhancements such as a virtual desktop, color calibration, and a screen-centering facility, the Turbo 1600 supports on-the-fly



resolution switching and a hotkey-triggered resolution/color-depth swapping utility called WinSwitch.

This utility lets you cycle through four-color depth/resolution combinations without restarting Windows. WinSwitch handles all data in 24-bit color mode, however, so regardless of the color depth displayed, you're stuck with the performance penalty of 24-bit color and the corresponding resolution limits of your hardware.

Two unusual options, 256 Color Palette and Dithering, are aimed primarily at videocentric applications. Used in 8-bit color modes, they let you enable palette swapping (the default is off) and turn off Windows' dithering. Swapping is required by several video codecs, and by turning off Windows' dithering you can speed up overall performance without degrading video playback quality.

The Turbo 1600 includes integrated video-acceleration support, but we found its capabilities in that respect to be relatively weak. Several randomly selected stretches on a 30-frame-per-second 320-by-240-pixel video file quickly bogged down a 90-MHz Pentium test system, causing an excessive number of dropped frames.

Our tests showed the Turbo 1600 to be highly competitive on standard graphics functions, however. Its Winstone 95 and Graphics WinMark 95 performance would have made it one of the top-performing products in this roundup. The card maintained a reasonable refresh rate until we raised the resolution to 1,600 by 1,200 pixels, but in 16-bit color mode at that resolution, the refresh rate dropped to a flicker-prone 60 Hz (the manual claims a 75-Hz refresh rate).

The Turbo 1600 offers a stable set of drivers with several forward-looking features and a high level of performance overall. CAD or image-editing professionals may be better off with one of the (admittedly more expensive) products that is tuned more finely for their needs. But if the final shipping version can live up to its claim of a 75-Hz refresh rate at 1,600 by 1,200 pixels in 16-bit color, the Turbo 1600 will represent a very sound choice for demanding general-business users. □

SUITABILITY TO TASK

Graphics Pro Turbo 1600	
Raster graphics	Good
Vector graphics	Good
CAD	Good
Mainstream usability	Good

Graphics Pro Turbo 1600. *List price: $799. ATI Technologies Inc., 33 Commerce Valley Dr. East, Thornhill, Ontario, Canada, L3T 7N6; 905-882-2626; fax, 905-882-2620.*

Circle 465 on reader service card

easy to follow and provides the best-organized, most complete monitor support in the industry. Selecting a monitor is as simple as choosing the manufacturer and model from impressively comprehensive lists. On the off chance that you don't find a match, you can create a custom monitor file or use the card's VDIF (Video Display Information File) support to read the monitor parameters directly (if your monitor supports VDIF). ELSA also provides well-designed DOS- and Windows-based test screens so you can fine-tune the card's parameters and save the resulting settings.

SUITABILITY TO TASK

Winner2000Pro/X	
Raster graphics	Fair
Vector graphics	Good
CAD	Excellent
Mainstream usability	Good

SUPER UTILITIES

After you choose a monitor, you can begin to configure ELSA's bevy of superhero Windows utilities. RUNman provides shortcuts to Windows applications, hotkeys for hardware pans and zooms, and resolution switching (but not color-depth swaps) without leaving Windows. DESKman gives you control over virtual-desktop configurations. Desktop publishers will appreciate GAMMAman, a full-featured color-calibration/gamma-correction utility, and ERGONOmeter, which displays the refresh rate, scan frequency, and screen size in dots per inch.

MULTIman is of particular interest to

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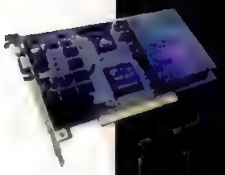

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CIRCLE 058 ON READER SERVICE CARD

Performance Tests: High-End Graphics Cards

Consistency of performance and driver optimization—not first-place finishes on the standard benchmark tests—were the hallmarks of the Diamond Stealth 64 Video VRAM and the #9 Imagine128 Pro 8MB, the finest products we saw.

What the Numbers Mean

The Raster Rotate, Vector File Open, AutoCAD 3-D Pan, and AutoCAD Redraw All charts show results in seconds; lower numbers indicate better performance. The relatively small range of scores on the raster and vector tests is due to overhead for CPU, memory, and disk access that is common to all products. The measured differences are nonetheless significant.

The Winstone 95 chart shows results for 1,024-by-768 resolution with 24-bit color. Winstone scores are a good indicator of a card's performance when it is running a variety of Windows-based applications.

Our Graphics WinMark 95 charts (part of the WinBench 95 benchmark test suite) start with results for 1,200-by-1,024 resolution with 24-bit color. This is probably the minimum resolution you would run on a 17-inch or larger monitor for graphics design or CAD work. We then show Graphics WinMark scores for 1,600-by-1,200 resolution with 16-bit color.

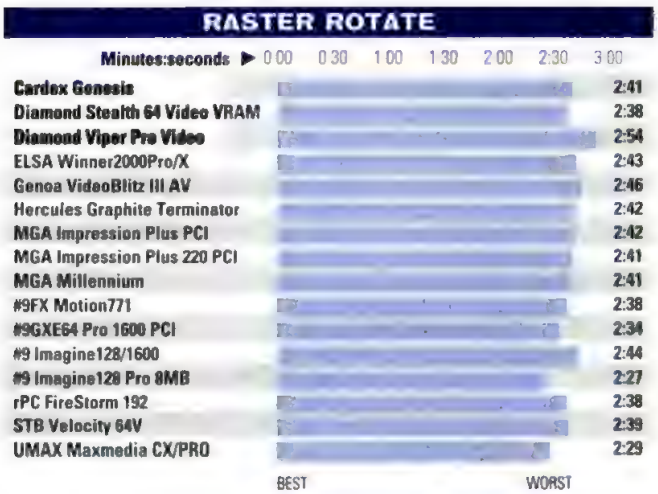
At this lower color depth, there is far less differentiation among cards. This is because 16-bit color images can actually be stored in half the amount of data needed for true-color images. Most true-color data, commonly referred to as 24-bit color, requires a full 32 bits per pixel. The extra 8 bits are used for an alpha channel, which can hold information about the 24-bit image, such as transparency masks or selection objects.

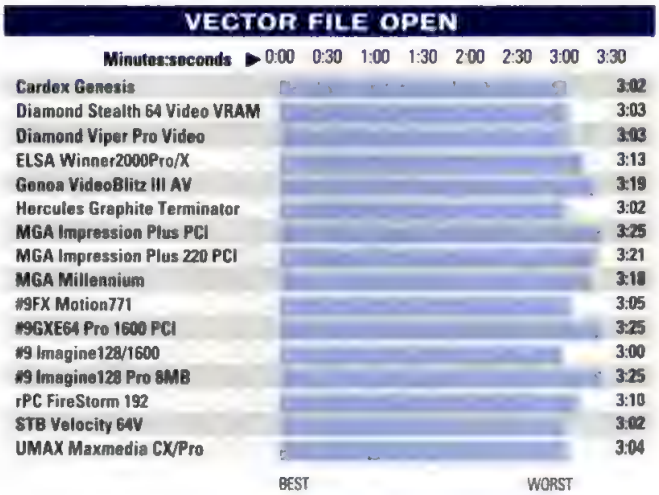
The TIFF 6 specification designates tags for alpha-channel information, thus moving it out of proprietary file formats and making it available for mainstream consumption. Graphics card drivers need to check for alpha-channel initialization and turn off optimizations like packed-pixel routines to display the image. The alpha channel doubles bandwidth requirements from 16-bit to 24-bit color, giving stronger cards a chance to outclass the weaker. For Winstone and Graphics WinMark tests, higher weighted scores indicate better performance.

The MGA Millennium grabbed the top scores across all standard benchmark tests but failed to come through on our real-world Raster Rotate and Vector File Open tests. In WinBench 95, the Millennium does especially well on the tests that draw to color-memory bitmaps. It does this by caching the color-memory bitmap in unused space on the frame buffer and using the accelerator hardware to achieve high pixel throughput. The Millennium's use of WRAM aids this type of operation. WinBench 95 is built to simulate mainstream Windows usage, and as such it employs a somewhat limited number of memory bitmaps that are neither very large nor very complex. The Millennium's 8MB frame buffer offers more than enough room to store them. It was not able to cache the 16.5MB TIFF image used in our Raster Rotate test, however; here, the Millennium's performance fell to the midrange. When we turned off device bitmaps on the Millennium, its Graphics WinMark scores dropped more than 16 percent. We believe that this card requires additional driver optimization work to improve performance when working with large color images.

The #9 Imagine128 Pro 8MB easily ranked among the top performers on many of our tests because of its 128-bit data pathway to video memory and its high-speed RAMDAC. The controller pinout has 128 pins, of which all are used for the physical data pathway. This enables the unencumbered transfer of four 32-bit-color data blocks per clock cycle. Additional analysis of individual WinBench tests showed that the card's driver is very well optimized for some of the more esoteric raster operations. This translated to excellent performance on our Raster Rotate and Winstone tests.

rPC's FireStorm 192 and UMAX's Maxmedia CX/Pro, which both use three S3 Vision 864 chips running in tandem to create a 192-bit data path, performed at the top on several BitBlt (bit-block transfer) tests in the WinBench test suite. On the Color Bitmap Screen-to-Screen BitBlt SRCCOPY

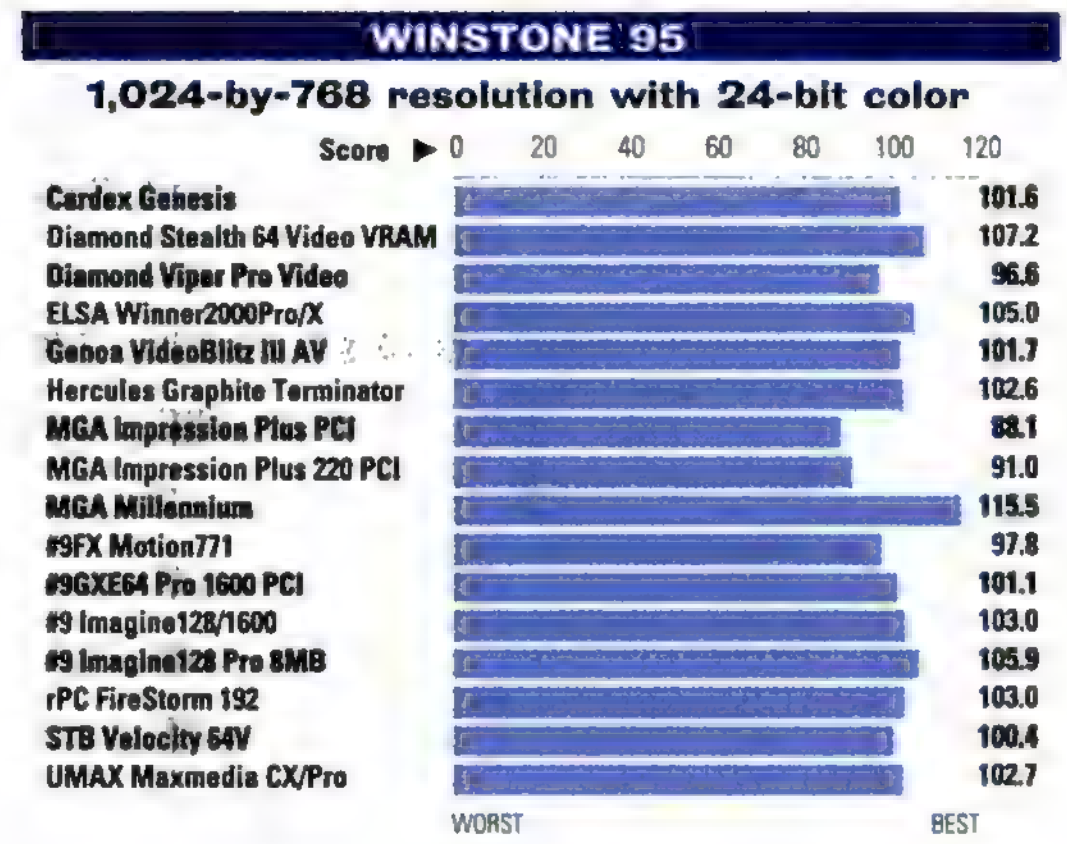


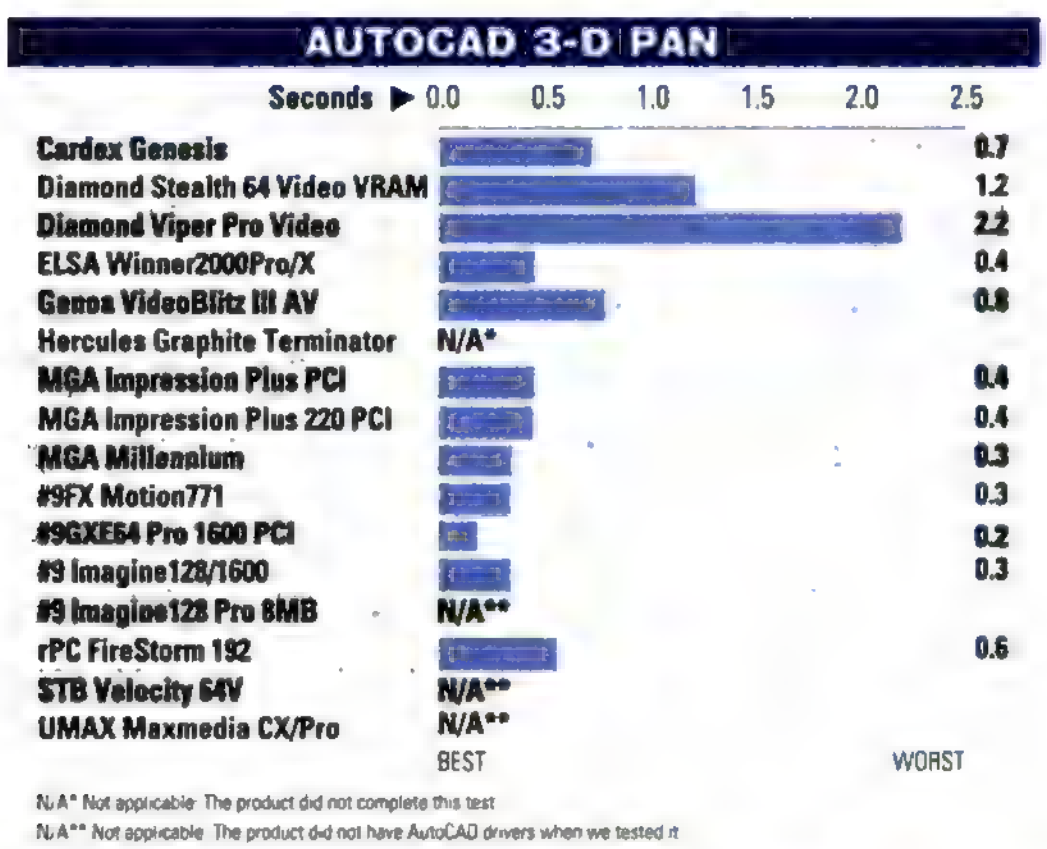


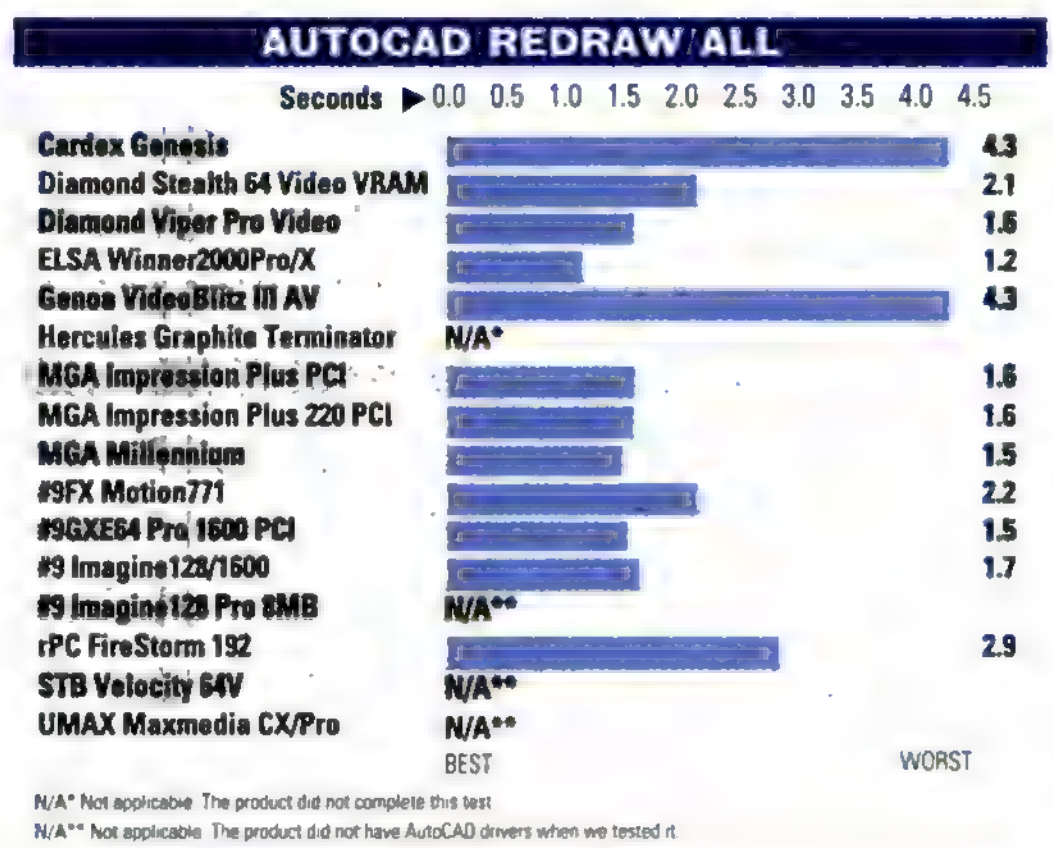
test (which copies a source rectangle directly to a destination rectangle), these cards doubled the performance of the MGA Millennium (data not presented). Both proved worthy contenders on our Raster Rotate and Vector File Open tests, probably the best indicators of real-world graphics-workstation performance in our test suite.

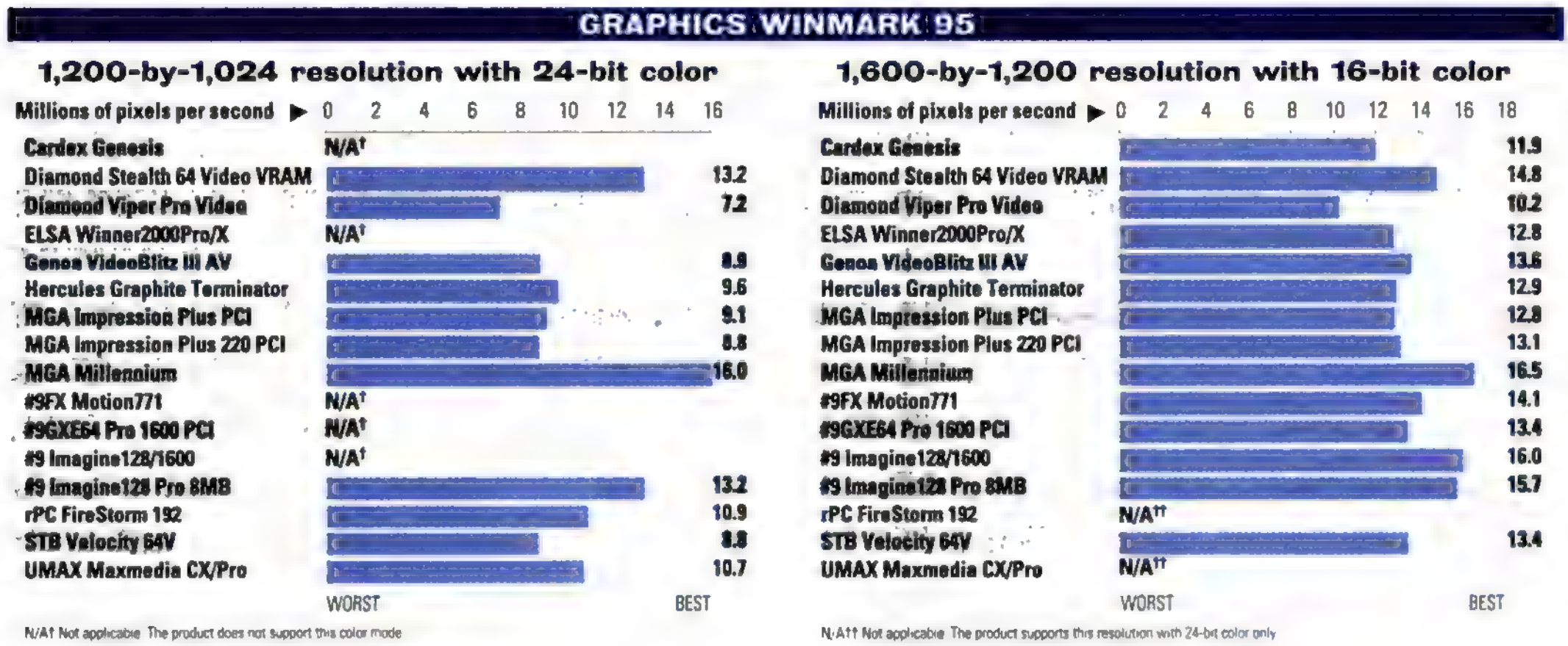
Diamond Multimedia Systems' Stealth 64 Video VRAM performed better overall than other cards based on the S3 Vision 968. This may in part be due to running the S3 Vision 968 and RAMDAC beyond manufacturers' electrical specification, although we saw no indications of hardware overload during our 72-hour torture tests. The 4MB card's top-ranking scores on many tests can also be attributed to excellent driver optimizations and S3's packed-pixel scheme.

ELSA's Winner2000Pro/X, the MGA Millennium, and the #9GXE64 Pro 1600 PCI all excelled on our AutoCAD tests. Differences between cards based on the same chip are directly attributable to the quality of the AutoCAD DLDs.

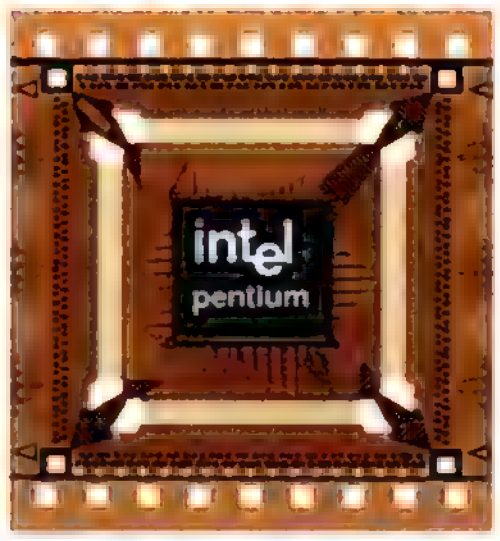








MOBILE PENTIUM.



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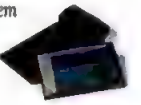

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CIRCLE 379 ON READER SERVICE CARD

How We Tested

Our test-bed consisted of HP Vectra XU 5/90C Pentium 90 systems equipped with 16MB of RAM and 256K L2 cache. Each test system was configured with MS-DOS 6.2 and Microsoft Windows 3.1 using a 42MB permanent swap file and with 32-bit disk access enabled. Each system also had a Quantum 540MB Enhanced-IDE hard disk, a Toshiba XM-4103 CD-ROM drive, and a Mag Innovision 17 MXP-17F monitor. To test cards at ultrahigh refresh rates, we used the following 21 inch monitors: the Radius Super-Match 21 T XL, NSA Hitachi SuperScan Supreme 21, and Nanao FX2-21. We used the Extron SRI to determine actual vertical and horizontal refresh rates.

Our test applications included Adobe Photoshop for Windows 3.0, AutoCAD Release 12 for DOS, CorelDRAW 5.0, Microsoft Excel 5.0, Microsoft Word for Windows 6.0, Paradox for Windows 5.0, and Shapeware Corp.'s Visio 3.0. We also installed ELAN Software Corp.'s GoldMine 2.5 for DOS and Mustang Software's DOS-based Qmodem 5.0. We used V Communications' Boot Commander to set up different boot sequences for AutoCAD and Windows.

We used PC Labs' Winstone 95 and WinBench 95 to test core Windows performance at several different resolutions (for a detailed description of these test suites, see "Benchmark Tests: Mainstream Graphics Accelerators," December 6, 1994). The benchmark tests have a 3 percent margin of error.

To test CAD performance, we use a custom version of the San Diego AutoCAD Users Group benchmark tests developed by Chris DeLucci. This version has been specially designed for *PC Magazine* to test graphics operations relevant to evaluating a graphics card's performance in AutoCAD. We tested only cards that provided AutoCAD DLDs. We used the drivers and any proprietary command functions they supported for common functions such as pan, zoom, and redraw. We initially set the resolution to 1,024-by-768 with 256 colors; the render test ran at 1,024-by-768 with 24-bit color. The tests include normal AutoCAD operations such as 3-D pan and zoom, iconic menu display, text zoom, redraw, and regenerate. Results are reported in seconds.

Our Vector File Open test uses CorelDRAW in 1,024-by-768 resolution with 24-bit color. We perform a file-open routine using a complex test file, measuring the time it takes to draw to the screen. The file contains hundreds of 24-bit gradations and over 750 graphical draw elements using complex clipping paths. This test exploits common and esoteric Windows GDI calls and exercises each graphics controller's ability to render vector graphics such as polygons, line draws, and area fills. We run the test three times and report the average timing, in minutes and seconds, for each product.

For our Raster Rotate test, we use Adobe Photoshop 3.0 running at 1,024-by-768 resolution with 24-bit color to perform bit-block transfers in our 16.5MB file. This 32-bit TIFF file contains an 8-bit alpha channel that resides above the 24-bit RGB channels. We measure the time required to rotate our test image 153 degrees counterclockwise. Because alpha channels tags are now supported in the TIFF 6 specification, we evaluate the impact the alpha channel has on drivers that use pixel-packing schemes in 32-bit data modes and tested the performance impact at 24-bit modes.

Our driver stability tests involve simultaneously running several Windows applications and a DOS application (in a DOS window); we switch between them in a variety of color depths and resolutions. This reduces the available Windows resources to less than 26 percent. These tests let us gauge how stable the drivers are under the most severe real-world circumstances (results are discussed in the reviews).

—Analysis written by Jeff Mace

CAD users. You can install up to three Winner2000Pro/X cards in a single PC and configure MULTIman to display separate views on up to three monitors. ELSA's POWERdraft AutoCAD/Windows DLD drivers include SuperView, MagniView, and MultiView. You can optimize one card/monitor pair to display aerial or magnified views of the project, maintain a list of previous views on another, and use the third to display customizable, floating ELSAicon menus.

ELSA's CAD support is robust and includes ELSArender, an optional 3-D rendering engine. Under Windows, the Winner2000Pro/X's S3 Vision 968 chip can use DCI to accelerate video and animated 3-D playback (the DCI drivers were not ready in time for this roundup).

Our performance and benchmark test results revealed adequate if less-than-awe-inspiring response. Other 968-based cards outperformed the Winner2000-Pro/X in terms of sheer speed, but ELSA's drivers were stable and its Windows and CAD utilities provide useful productivity enhancements. The card did well on our Winstone 95 test suite, indicating strong performance on mainstream business applications. Still, the Winner-2000Pro/X distinguishes itself primarily through its versatile CAD support.

Winner2000Pro/X. *List price: $699. ELSA Inc., 2041 Mission College Blvd., #165, Santa Clara, CA 95054; 800-272-3572, 415-615-7799; fax, 415-588-0113.*

Circle 457 on reader service card

Genoa Systems Corp.

VideoBlitz III AV

BY JAN OZER

Reasonably priced at $629 for the 4MB version, Genoa System Corp.'s VideoBlitz III AV offers average hardware performance combined with an engaging and accessible set of software amenities and exceptionally stable operation. Though clearly not designed for life on the cutting edge, the VideoBlitz is ideal for users seeking reliable acceleration of graphics and video playback.

The VideoBlitz is designed around the S3 Vision 968 integrated graphics controller/ video scaler chip, IBM's 170-MHz RGB514 RAMDAC, and either 2MB or 4MB of VRAM. The 4MB card we tested delivered a maximum resolution of 1,600 by 1,200 pixels at 16-bit color with a 72-Hz vertical refresh rate and 1,280 by 1,024 pixels at 24-bit color with a 75-Hz refresh. These are midrange specs only; those spending long hours working on big-screen graphics may want to consider faster cards.

SUITABILITY TO TASK	VideoBlitz III AV
Raster graphics	Fair
Vector graphics	Fair
CAD	Fair
Mainstream usability	Good

THE BENCHMARK BLUES

Unlike several other cards we tested, the VideoBlitz successfully completed every benchmark test—albeit with less-than-stellar scores. On the Graphics WinMark 95 tests, the VideoBlitz placed respectably in the midrange at 1,600-by-1,200 resolution with 16-bit colors, but it fell closer to the bottom of the pack at 1,200-by-1,024 resolution with 24-bit color. Along with the other Vision 968–based cards, the VideoBlitz was a middling performer. The VideoBlitz ranked fifth from the bottom on our Vector File Open test and sec-

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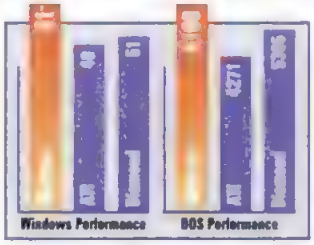

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CIRCLE 124 ON READER SERVICE CARD

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PC MAGAZINE EDITORS' CHOICE May 30, 1995 ABC FlowCharter 4.0

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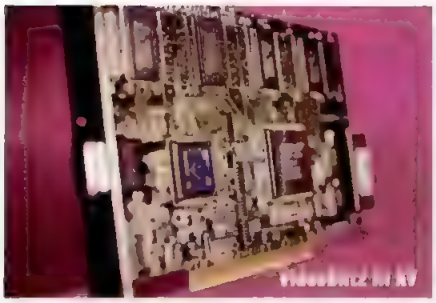
CIRCLE 361 ON READER SERVICE CARD

ond from the bottom on our Raster Rotate test. On both those tests, the VideoBlitz was the slowest S3 Vision 968–based card. It also ranked near the bottom on both of our AutoCAD tests.



On the plus side, the VideoBlitz was totally unruffled by our driver stability tests, which are designed to bend, fold, spindle, and mutilate graphics drivers—and often do. Anyone who has ever lost a few hours of work due to an ill-timed General Protection Fault will treasure this stability.

CREATURE COMFORTS

The card is solid and well constructed, and the DOS- or Windows-based installation routines were easy to follow. One surprising omission is the lack of any monitor presets, a real security blanket for users who have long since discarded their monitor manual. You set refresh rates either in SYNC.COM, a DOS application that writes the startup configuration into AUTOEXEC.BAT, or in ProPilot, Genoa's new Windows-based screen-control utility.

Although it lacks critical graphics utilities such as color calibration and gamma control, ProPilot compensates with innovative, well-designed features that enhance more mainstream applications like word processing and spreadsheets. ProPilot offers on-the-fly resolution switching but not color-depth adjustment without rebooting Windows, putting you a keystroke away from more columns on your spreadsheet. You can also change the refresh rate without rebooting Windows—useful when exploring high-resolution operations.

Genoa also includes the requisite display power management signaling (DPMS) power-down features and four hotkey color-depth/resolution presets enabling one-key switching between environments customized for your various applications.

Make no mistake: VideoBlitz, with its average refresh rates, middling benchmark-test performance, and lack of color controls, is not a card for graphics professionals. But it offers a refreshing combination of useful and accessible features, operational stability, and hardware performance that should prove very attractive to a broad swath of mainstream users.

VideoBlitz III AV. *List price: $629. Genoa Systems Corp., 75 E. Trimble Rd., San Jose, CA 95131; 800-734-3662; fax, 408-434-0997.*

458 on reader service card

Hercules Computer Technology Inc.

Graphite Terminator Professional

BY JAMES KARNEY

The Graphite Terminator Professional is to a high-end graphics adapter what a cup of plain coffee is to a latte: It gets the job done, but without much panache. Listing at $649, this S3 Vision 968–based card is equipped with

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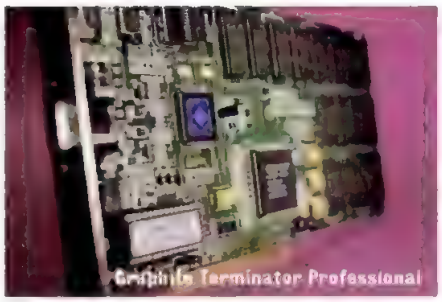
Add-on Computer Module	PSN2	59
Add-on Printer Module	PSN3	69

CIRCLE 150 ON READER SERVICE CARD

4MB of VRAM and a 220-MHz RAMDAC. This combination offers a top display of 1,600 by 1,200 pixels in 16-bit color with a pedestrian 76-Hz vertical refresh rate. We found the card to be a capable midrange performer but lacking in the elegance and ease-of-use features that graphics professionals have come to expect.


Graphite Terminator Professional

The first taste of its vanilla approach becomes apparent during Windows setup. If you are using a standard display that is on the Terminator Pro's list of supported monitors, all is well. If not, you must either accept a generic setting based on your monitor's scan rates or set the rate using a DOS command line parameter based on a value from a table in the Terminator Pro's manual. There are no provisions for an interactive Windows-based installation that lets you tune the card to a monitor and then test compatibility, a feature found in many other cards in this price range.

The manual does contain the information you will need to get things up and running, but it is quite terse and will probably intimidate the new or inexperienced user. Overall, the Terminator Pro would benefit from a better installation routine and better documentation. Hercules has indicated that it is working on an improved installation utility, which will probably be incorporated into a Microsoft Windows 95 driver that will be available by the time the new 32-bit operating system ships.

Once you have the Windows drivers set up correctly, you can change resolution and color depth with Hercules's Picture Window utility, but you must exit and reload Windows to effect the change. You can use the Adjust feature to position the image on the screen, and you can view (but not adjust) the refresh rate with the Refresh Rate Meter. For systems that have power-management support, the Terminator Pro provides a power-down function to enable VESA DPMS monitor functions.

Our benchmark testing showed the Terminator Pro to be running on a par with other products built around the S3 Vision 968 chip. Its Graphics WinMark 95 scores were in the midrange, as was its performance on our applications-based Winstone 95 tests. It landed in the top third on the Raster Rotate test, although it was one of the poorest Vector File Open performers we saw. Our driver stability tests did not turn up any problems. Unfortunately, the company was not able to supply working AutoCAD drivers for our review.

The card provides Video and MPEG operations, which are handled via Hercules's

SUITABILITY TO TASK

Graphite Terminator Professional	
Raster graphics	Fair
Vector graphics	Fair
CAD	N/A
Mainstream usability	Good

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Power Playback software. This provides basic Video for Windows and DCI-based codecs for playing video clips in a window or scaled to full-screen. The actual linear scaling and color-space conversion are performed by the S3 Vision 968 chip. Though we did notice some minor color degradation, the video playback worked well overall.

The Terminator Pro is a well-designed if somewhat nondescript product backed by very stable drivers and a five-year warranty. When we called Hercules's technical support, we were connected with someone who understood the product and could answer our questions. If you don't want or need the extra features found in more expensive products, the Terminator Pro might fill the bill. But if you need every ounce of performance and more powerful utilities, it would pay you to shop further.

Graphite Terminator Professional. *List price: $649. Hercules Computer Technology Inc., 3839 Spinnaker Ct., Fremont, CA 94538; 800-532-0600; 510-623-6030; fax, 510-623-1112.*

Circle 459 on reader service card

Matrox Graphics Inc.

MGA Impression Plus PCI MGA Impression Plus 220 PCI

BY JOHN R. QUAIN

When it was introduced last year, Matrox Graphics' $599 MGA Impression Plus PCI card was one of the best and brightest GUI acceleration products *PC Magazine* had tested. But things change quickly. This year, Matrox's two Impression offerings, the MGA Impression Plus PCI and the MGA Impression Plus 220 PCI, are pitted against heavy hitters that have better batting averages in both the Windows acceleration and image-editing arenas.

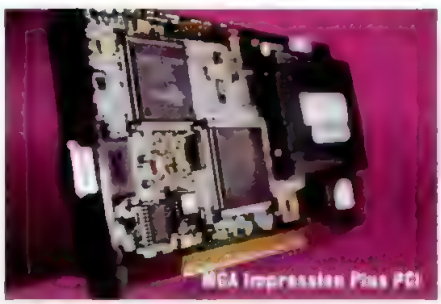
The Impression Plus cards offer some flair in the form of built-in hardware 3-D acceleration, and their ease-of-use features remain broadly appealing. Their position on the price/performance scale will make these cards attractive for high-end business applications, but desktop illustrators and designers who are looking for a true-color workhorse will find better players on the field.

HOMEGROWN ACCELERATOR

Designed around the company's own 64-bit MGA graphics accelerator chip, both Impression Plus models we tested came with 4MB of VRAM and Texas Instruments' 64-bit PTVP3026 RAMDAC. The standard $599 model of the Impression Plus PCI comes with a 175-MHz version of the PTVP3026, while the $699 Impression Plus 220 PCI boasts a 220-MHz version of the RAMDAC.

The Impression Plus cards are primarily intended for high-end business applications and entry-level desktop publishing.

In its standard configuration, the Impression Plus PCI can display resolutions up to 1,600 by 1,200 pixels in 16-bit color at 72 Hz. True (24-bit) color can be had in resolutions as high as 1,280-by-1,024 with a 76-Hz refresh rate. The primary benefit of the faster $70 RAMDAC option is that it will yield a vertical refresh rate of up to 85 Hz at the maximum resolution of 1,600 by 1,200 pixels and an eye-saving 110-Hz vertical refresh rate in 1,280-by-1,024 resolution.



In terms of 3-D hardware support, the primary difference between these cards and Matrox's more expensive MGA Millennium (also reviewed in this story) is that the Impression Plus cards do not offer 3-D Gourand shading acceleration in 24-bit color modes. You can, however, get noticeable 3-D acceleration in 16-bit color modes up to 800-by-600 resolution. The Impression Plus cards also ship with a Display Control Interface (DCI) driver to accelerate the next generation of Windows 95 WinG-based games.

SUITABILITY TO TASK	MGA Impression Plus PCI
Raster graphics	Fair
Vector graphics	Fair
CAD	Good
Mainstream usability	Good

Setup for both cards was virtually trouble-free despite their extensive list of features. The only cause for complaint was the disabled advanced setup feature we also encountered with the company's Millennium card. To invoke these fine-tuning controls, you now have to use a software switch.

Unfortunately, the Impression Plus cards' benchmark performance did not live up to their ease of use. On our applications-based Winstone 95 tests, run in 24-bit color mode at 1,024-by-768 resolution, the cards turned in lower scores than any other product. Two runs of our Graphics WinMark 95 tests placed both Impression Plus cards firmly in the lower ranges of the lineup.

Things did not improve on the real-world Vector File Open test. In managing detailed vector graphics, both cards fell near the bottom of the pack. The outlook for true-color work looked better when it came to handling raster graphics in Photoshop. On the Raster Rotate test, the two Impression cards yielded squarely average times.

AutoCAD results were still more promising, landing both versions of the Impression Plus solidly above the middle of the pack. Although Matrox's DLDs were some of the more stable AutoCAD drivers we tested, there were still minor problems with unlit pixels on some arrows and the occasional missing scan line. Otherwise, AutoCAD maneuvers transpired without a hitch.

One bright spot was the fact that the Impression Plus pair proved to be reliable graphics journeymen—even under stressful Windows working conditions. Both managed to run all the concurrent Windows and DOS applications we threw at them in our driver stability tests, even while connected to a network.

NOT SOFT ON HELP

Matrox continues to win favor with users for its Power Desk

SUMMARY OF FEATURES

High-End Graphics Cards

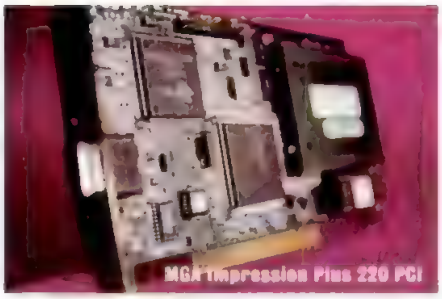
■ YES ■ NO
In alphabetical order by company

	Cardexpert Technology Inc. **Cardex Genesis**	Diamond Multimedia Systems Inc. **Stealth 64 Video VRAM** (PC MAGAZINE EDITORS' CHOICE)	Diamond Multimedia Systems Inc. **Viper Pro Video**	ELSA Inc. **Winner2000-Pro/X**	Genoa Systems Corp. **VideoBlitz III AV**	Hercules Computer Technology Inc. **Graphite Terminator Professional**	Matrox Graphics Inc. **MGA Impression Plus PCI**
Price of tested configuration	$439 (list)	$559 (street)	$649 (street)	$699 (list)	$629 (list)	$569 (list)	$599 (list)
Graphics accelerator chip	S3 Vision 964	S3 Vision 968	Weitek Power 9100	S3 Vision 968	S3 Vision 968	S3 Vision 968	MGA 64-bit
VGA BIOS manufacturer	S3	Diamond	Diamond	ELSA	Phoenix	Phoenix	Matrox
Display Characteristics							
Maximum noninterlaced resolution (dpi)	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200
Maximum number of colors at:							
1,600-by-1,200 resolution	65,000	65,000	65,000	65,000	65,000	65,000	65,000
1,280-by-1,024 resolution	65,000	16.7 million	16.7 million	65,000	16.7 million	16.7 million	16.7 million
1,024-by-768 resolution	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
Maximum noninterlaced refresh rate with maximum color depth at:							
1,600-by-1,200 resolution	60 Hz	76 Hz	66 Hz	80 Hz	72 Hz	76 Hz[1]	72 Hz
1,280-by-1,024 resolution	75 Hz	100 Hz[1]	75 Hz	104 Hz	75 Hz	100 Hz[1]	76 Hz
1,024-by-768 resolution	75 Hz	120 Hz[1]	100 Hz	104 Hz	84 Hz	120 Hz[1]	76 Hz
Preset refresh rate for specific monitors	■	■	■	■	■	■	■
Custom refresh rate for specific monitors	■	■	■	■	■	■	■
Frame-buffer features:							
Display memory	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM	4MB VRAM
User-installable memory upgrade	■	■	■	■	■	■	■
Maximum installable memory	4MB	4MB	4MB	8MB	4MB	4MB	4MB
RAMDAC features:							
Manufacturer and model number	IBM RGB525	TI PTVP3026	IBM RGB525	TI PTVP3026	IBM RGB514	IBM RGB524	TI PTVP3026
Clock speed	175 MHz	220 MHz	175 MHz	220 MHz	170 MHz	220 MHz	175 MHz
Software Drivers							
AutoCAD (Revision 12)	■	■	■	■	■	■	■
Protected-mode ADI	■	■	■	■	■	■	■
Display-list processor or driver	■	■	■	■	■	■	■
8514/A	■	■	■	■	■	■	■
Microsoft Windows NT 3.5	■	■	Optional	■	■	■	■
OS/2 Warp, Version 3	■	■	■	■	■	■	■
AutoCAD Features							
Bird's-eye zoom	■	■	■	■	■	■	■
Text window	■	■	■	■	■	■	■
Chip Features							
Bitmap caching	■	■	■	■	■	■	■
Font caching	■	■	■	■	■	■	■
Hardware video acceleration	■	■	■	■	■	■	■
True x, y video scaling	■	■	■	■	■	■	■
Microsoft Windows Utilities							
Resolution switching	■	■	■	■	■	■	■
Virtual desktop	■	■	■	■	■	■	■
Maximum resolution	N/A	2,048 x 1,536	N/A	1,600 x 1,200	1,600 x 1,200	N/A	1,600 x 1,200
Pan/Zoom	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Color calibration/Gamma correction	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Windows/DOS monitor tuning	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Windows/DOS installation	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Customer Support							
Toll-free technical support	■	■	■	■	■	■	■
Toll-free number	None	800-468-5846	800-468-5846	800-272-3572	None	800-532-0600	800-361-1408
Toll number	510-252-1118	408-325-7000	408-325-7000	408-565-9669	408-432-9090	510-623-6030	514-685-2630
BBS number	510-354-3800	408-325-7175	408-325-7175	408-565-9630	408-943-1231	510-623-7449	514-685-6008
Warranty	3 years	5 years	5 years	3 years	2 years	5 years	2 years
Upgrade/return policy	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■

N/A Not applicable The product does not have this feature 1 We were not able to verify this refresh rate in testing 2 AutoCAD drivers are available, although we did not receive them in time for testing

High-End Graphics Cards

	Matrox Graphics Inc. **MGA Impression Plus 220 PCI**	Matrox Graphics Inc. **MGA Millennium**	Number Nine Visual Technology Corp. **#9FX Motion771**	Number Nine Visual Technology Corp. **#9GXE64 Pro 1600 PCI**	Number Nine Visual Technology Corp. **#9 Imagine128/ 1600**	PC MAGAZINE EDITORS' CHOICE Number Nine Visual Technology Corp. **#9 Imagine128 Pro 8MB**	rPC, a division of Radius Inc. **FireStorm 192**	STB Systems Inc. **Velocity 64V**	UMAX Technologies Inc. **Maxmedia CX/Pro**
	$699 (list)	$948 (list)	$499 (street)	$799 (street)	$1,199 (street)	$1,999 (street)	$999 (list)	$449 (list)	$1,299 (list)
	MGA 64-bit	MGA-2064W	S3 Vision 968	S3 Vision 964	Imagine128	Imagine128	S3 Vision 864	S3 Vision 968	S3 Vision 864
	Matrox	Matrox	Number Nine	Number Nine	Number Nine	Number Nine	Phoenix	STB	UMAX
	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200	1,920 x 1,060	1,600 x 1,200	1,600 x 1,200	1,600 x 1,200
	65,000	16.7 million	65,000	65,000	65,000	16.7 million	16.7 million	65,000	16.7 million
	16.7 million	16.7 million	65,000	65,000	65,000	16.7 million	16.7 million	16.7 million	16.7 million
	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
	85 Hz	72 Hz	75 Hz	76 Hz	79 Hz	72 Hz	66 Hz	80 Hz	66 Hz
	110 Hz	90 Hz	85 Hz	76 Hz	90 Hz	112 Hz	85 Hz	85 Hz	90 Hz[1]
	120 Hz	120 Hz	93 Hz	120 Hz[1]	185 Hz[1]	156 Hz[1]	120 Hz[1]	100 Hz	120 Hz[1]
	■	■	■	■	▫	▫	■	■	■
	■	■	■	■	■	■	■	■	■
	4MB VRAM	8MB WRAM	4MB VRAM	4MB VRAM	4MB VRAM	8MB VRAM	6MB DRAM	4MB EDO VRAM	6MB DRAM
	■	■	▫	▫	■	■	▫	▫	▫
	4MB	8MB	4MB	4MB	4MB	8MB	6MB	4MB	6MB
	TI PTVP3026	TI PTVP3026	IBM RGB524	TI PTVP3025	TI PTVP3024	IBM RGB528	TI PTVP3026	IBM RGB524	TI PTVP3026
	220 MHz	175 MHz	220 MHz	220 MHz	220 MHz	220 MHz	175 MHz	220 MHz	175 MHz
	■	■	■	■	■	▫	■	■[2]	■[2]
	■	■	■	■	■	N/A	■	■[2]	■[2]
	■	■	■	■	■	N/A	■	■[2]	■[2]
	▫	▫	▫	▫	▫	▫	▫	▫	■
	■	■	▫	▫	■	▫	▫	■	■
	■	▫	■	■	■	▫	▫	■	Optional
	■	■	■	■	■	N/A	■	■[2]	■[2]
	■	■	■	■	■	N/A	■	■[2]	■[2]
	■	■	■	■	▫	▫	■	■	■
	■	■	■	■	■	■	■	■	■
	■	■	■	▫	■	■	▫	■	▫
	▫	▫	▫	▫	▫	▫	▫	▫	▫
	■	■	▫	▫	▫	■	■	■	▫
	■	■	■	■	■	■	■	■	■
	1,600 x 1,200	1,600 x 1,200	2,048 x 2,048	2,048 x 2,048	2,048 x 1,200	2,048 x 1,024	1,600 x 1,200	1,600 x 1,200	2,048 x 1,024
	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
	■ ■	■ ■	■ ■	■ ■	■ ■	■ ▫	■ ▫	■ ■	■ ▫
	■ ■	■ ■	■ ▫	■ ▫	■ ▫	■ ▫	■ ■	■ ■	■ ■
	▫	▫	▫	▫	▫	▫	■	■	■
	800-361-1408	800-361-1408	800-438-6163	800-438-6163	800-438-6163	800-438-6163	800-459-4772	800-234-4334	800-562-0311
	514-685-2630	514-685-2630	617-674-0009	617-674-0009	617-674-0009	617-674-0009	408-541-5400	214-234-8750	510-651-9488
	514-685-6008	514-685-6008	617-862-7502	617-862-7502	617-862-7502	617-862-7502	408-541-6190	214-437-9615	510-651-2550
	2 years	3 years	5 years	5 years	5 years	5 years	5 years	Lifetime	1 year
	▫ ▫	▫ ▫	■ ■	■ ■	■ ■	■ ■	▫ ▫	▫ ▫	▫ ▫


MGA Impression Plus 220 PCI

utilities. Among the included features are DPMS settings, hardware pan, a 4-to-1 zoom, and the ability to change resolutions and color depths without having to reboot Windows. The MGA control panel also lets you store four separate display modes with individual virtual desktops so that they can later be changed with a single button-click. You can also set up hotkeys and change the color of the hardware cursor for better visibility.

To help manage virtual-desktop displays, dialog boxes can be set to appear only in the center of the viewable screen, and Windows applications can be set so that they don't open outside of your current view. Don't worry if all these options sound like too much on-screen clutter; Matrox includes a small Quick Access control panel that allows you to adjust just about every setting without having to go through a series of dialog boxes.

The MGA Impression Plus PCI and MGA Impression Plus 220 PCI are primarily intended for high-end business applications and entry-level desktop publishing tasks. Those entering the animation arena should also find the cards' 3-D support enticing. Unfortunately, neither one of the Impression Plus cards will raise eyebrows among those users looking for strong performance in a true-color Windows, DTP, or CAD graphics adapter.

SUITABILITY TO TASK

MGA Impression Plus 220 PCI	
Raster graphics	Fair
Vector graphics	Fair
CAD	Good
Mainstream usability	Good

MGA Impression Plus PCI. *List price: $599.* **MGA Impression Plus 220 PCI.** *List price: $699. Matrox Graphics Inc., 1055 St. Regis Blvd., Dorval, Quebec, Canada, H9P 2T4; 800-361-1408, 514-685-2630; fax, 514-685-2853.*

Circle 460 on reader service card

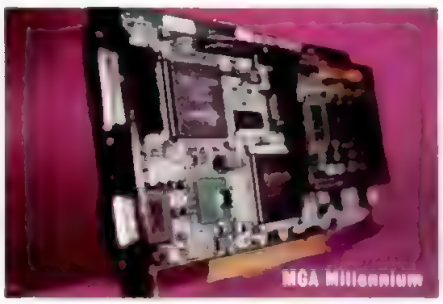
Matrox Graphics Inc.

MGA Millennium

By John R. Quain

Trying to satisfy every computer user's graphics needs with a single card is tricky. But with its newest adapter, the $948 MGA Millennium, Matrox has attempted to do just that. The Millennium boasts top-drawer Windows performance and 3-D skills, but those doing heavy-duty DTP or high-resolution photo manipulation won't find it as impressive.

Based on the company's new 64-bit MGA-2064W graphics controller, the Millennium offers beefed-up graphics and 3-D support. It also features 8MB of Windows RAM (WRAM). Using two 32-bit paths to the controller, the dual-ported WRAM is priced about on a par with VRAM but is designed to enhance specific graphics functions such as dual-color block writes for faster fills and text moves and aligned BitBlts for faster double buffering.


MGA Millennium

Anticipating an increase in 3-D graphics when Windows 95 finally appears, Matrox has set its sights on providing better hardware acceleration for upcoming 3-D APIs such as Microsoft's OpenGL and Intel's 3DR. The company has added hardware-assisted texture mapping and pumped up the chip's 3-D muscle with a graphics engine rated to display up to an impressive 190,000 16-bit Gourand-shaded triangles per second. In tests, 3-D tasks do appear to be much smoother. But the Millennium's real-time 3-D is restricted to a maximum 24-bit-color resolution of 1,024-by-768.

The Millennium displayed 24-bit color images at up to 1,600-by-1,200 with a vertical refresh rate of 72 Hz, which increases to 90 Hz in true-color 1,280-by-1,024 mode and to 120 Hz in 1,024-by-768 mode. The standard Millennium configuration uses Texas Instruments' PTVP3026 175-MHz, 64-bit RAMDAC, but the company plans to offer a 220-MHz RAMDAC as well.

Installation was relatively straightforward. The scant list of monitor presets won't cover everyone, but a test utility lets you set your own profile. Choosing specific refresh rates, however, means inserting a software switch in the command line.

The Millennium turned in some of the fastest 24-bit color scores we saw, taking first place on the 1,200-by-1,024 Graphics WinMark 95 tests and the 1,024-by-768 Winstone 95 tests. But a close look at the subcomponent scores that make up the Graphics WinMark result shows that the Millennium's drivers are not evenly optimized across a wide range of lesser-used Windows functions. On our AutoCAD tests, the card placed second overall. Only a minor glitch appeared here, with some incorrectly lit pixels on arrows in erase tests.

The Millennium's performance on the Vector File Open and Raster Rotate tests was in the midrange—a further indication that its drivers still need tuning for a broader range of real-world operations. In handling large vector drawings, the Millennium performed about average for this group. In dealing with raster moves, the card was a squarely average performer, drawing even with Matrox's less-expensive MGA Impression Plus 220 PCI.

To control all its bells and whistles, the Millennium uses the same Windows utilities offered with the MGA Impression Plus cards. Although it was unavailable in time for testing, a CD-ROM containing extensive help files, a software MPEG player, 3-D APIs, and 3-D demos will be included.

If 3-D animation and illustration is in your future, the Millennium is a good choice. Heavy DTP users and photo editors will want to consider other offerings in this roundup. The Millennium was among the fastest of the cards we tested, but others offer a better price/performance ratio.

SUITABILITY TO TASK

MGA Millennium	
Raster graphics	Fair
Vector graphics	Fair
CAD	Excellent
Mainstream usability	Excellent

MGA Millennium. *List price: $948. Matrox Graphics Inc., 1055 St. Regis Blvd., Dorval, Quebec, Canada, H9P 2T4; 800-361-1408, 514-685-2630; fax, 514-685-2853.*

Circle 460 on reader service card

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Photo Credit: Yuri Vendelen

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Standards	MPR-II, TCO

F2·17	
Dot Pitch	0.28mm
Scan Freq.	H:30-69kHz, V:55-120kHz
Rec. Resol.	1024 x 768 @ up to 87Hz
Max Resol.	1280 x 1024 @ up to 66Hz
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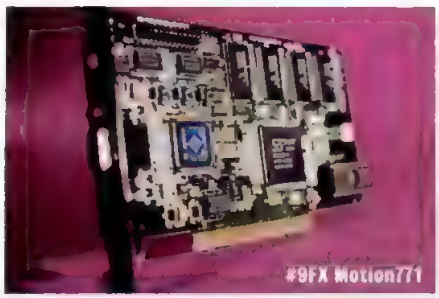
Number Nine Visual Technology Corp.

#9FX Motion771

BY DAVID A. HARVEY

The #9FX Motion771 falls squarely into the middle of the current crop of high-end graphics cards. Incapable of true-color resolutions higher than 1,152-by-864, this card isn't aiming at the high end. But driven by the latest S3 Vision 968 64-bit graphics accelerator, it offers respectable true-color performance at 1,024-by-768 for those whose needs aren't driven by super-high resolution and whose budgets demand cost-conscious solutions.



Like Number Nine's Imagine128 offerings (also reviewed here), the Motion771 comes with the outstanding HawkEye for Windows utilities set. If you're looking for a true-color-capable card with decent performance at true-color resolutions and above-average 16-bit Windows and 8-bit AutoCAD speeds, the Motion771 is an excellent choice.

Four megabytes of VRAM, a 220-MHz IBM RGB524 RAMDAC, and the S3 Vision 968 graphics controller add up to a strong hardware pedigree. The S3 Vision 968 controller delivers a solid set of features and performance enhancements, including the usual accelerated BitBlt, line-draw, and pattern-fill functions. New to the S3 Vision 968 is hardware video acceleration, and that is what puts the *motion* into the name of this card. The S3 Vision 968 hardware offers *x*-axis video scaling; the *y*-axis is implemented in the Motion771's DCI driver set. Though we didn't formally test video playback, we noticed that when we stretched Video for Windows clips on our test-bed, the resulting interpolated image was far finer and less pixelated than images on cards without video acceleration.

SUITABILITY TO TASK	#9FX Motion771
Raster graphics	Good
Vector graphics	Good
CAD	Good
Mainstream usability	Good

On our Graphics WinMark 95 tests, the Motion771 fell close to the bottom in 1,024-by-768 true color. A switch to 16-bit color at a resolution of 1,600 by 1,200 pixels brought the Motion771 to the top third of the line-up. Interestingly, on our Raster Rotate test, the Motion771 turned in an excellent performance—coming in fourth overall. On the AutoCAD 3-D Pan test, the card pulled into an impressive third place, while on both the Windows-based Vector File Open and the AutoCAD Redraw All tests, the Motion771 dropped back into the midrange.

Like the Imagine128 cards, the Motion771 comes with Number Nine's HawkEye for Windows utility suite. This sophisticated collection of setup, tuning, and configuration tools extends the card's functionality and usability tremendously. The Motion771's version of HawkEye also includes a monitor-selection utility and a set of advanced options to tune Windows performance. The monitor-selection utility lets you choose presets for specific monitor models. This may mean that you won't ever have to use the Monitor Adjustment utility to set refresh, but if you demand an ultra-high refresh rate (the default settings are on the conservative side), you'll need to spend some time fine-tuning. The advanced driver options are accessed through a pull-down menu on the #9 Status utility. Here you can toggle font and bitmap caching on and off and fine-tune other driver controls.

The DOS-based refresh-rate adjustment utility that's used to set the card up for AutoCAD and other DOS programs did not work correctly, however. When we opened the program and specified our target refresh rates, the app wrote an incorrect set of parameters to our AUTOEXEC.BAT file. We had to adjust AUTOEXEC.BAT manually to get the refresh rates we needed.

The Motion771 turns in middle-of-the-road performance, but its HawkEye utilities transport it into the high end of usability. If much of your work doesn't require true color at high resolutions and if you need both CAD and Windows speed, you'll find the Motion771 to be a very attractive card.

#9FX Motion771. *Estimated street price: $599. Number Nine Visual Technology Corp., 18 Hartwell Ave., Lexington, MA 02173; 800-438-6163, 617-674-0009; fax, 617-674-2919.*

Circle 461 on reader service card

Number Nine Visual Technology Corp.

#9GXE64 Pro 1600 PCI

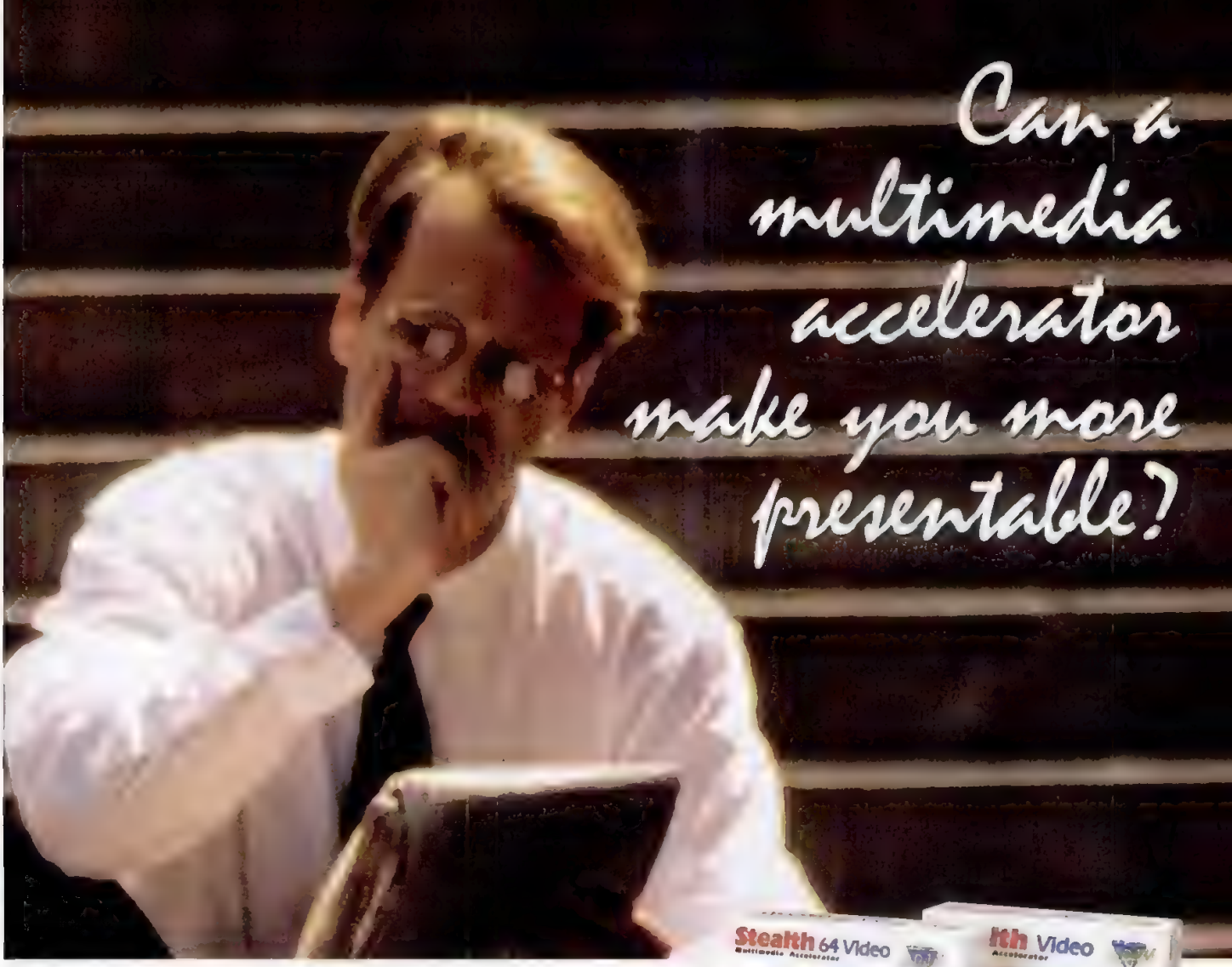
BY DAVID A. HARVEY

The #9GXE64 Pro 1600 PCI is the odd one out among the four Number Nine cards we reviewed. Based on the older S3 Vision 964 accelerator chip, the #9GXE64 Pro performs on a par with Number Nine's newer #9FX Motion771 graphics accelerator, yet it lacks that card's multimedia functions and costs $200 more. Given its somewhat pedestrian performance numbers and its inability to produce true color at resolutions higher than 1,152 by 864 pixels, the #9GXE64 Pro represents a questionable choice for Windows use.

The #9GXE64 Pro's shining moment is in its AutoCAD performance, however. On the 3-D Pan test, the card shot into first place; it took third place on our Redraw All test. But given the availability of more full-featured, less costly cards that incorporate later-generation accelerators, the #9GXE64 Pro would only make sense for someone who spends time in AutoCAD for DOS and doesn't need more than midrange Windows graphics performance.

SUITABILITY TO TASK	#9GXE64 Pro 1600 PCI
Raster graphics	Good
Vector graphics	Fair
CAD	Excellent
Mainstream usability	Good

Though the aging 64-bit S3 Vision 964 graphics accelerator is certainly nothing to sneeze at, this chip has been surpassed by later models from S3 and utterly outclassed by the latest chips from ATI Technologies, Matrox Graphics, and Number Nine. The S3 Vision 964 has all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Software Drivers Included

Windows 3.1	Windows for Workgroups 3.11
Windows NT 3.5	[illegible]
[illegible]	[illegible] Warp
MicroStation 5	And More

Video CODECs Supported

[illegible]	[illegible]
[illegible]	Indeo 3.2
[illegible]	MS Video 1
[illegible]	[illegible]

	Stealth 64 Video VRAM	Stealth Video
Controller	[illegible]	[illegible]
Vertical Refresh	[illegible]	[illegible]
Max. Hz	[illegible] x 1200	1280 x 1024
Memory	[illegible]	[illegible]

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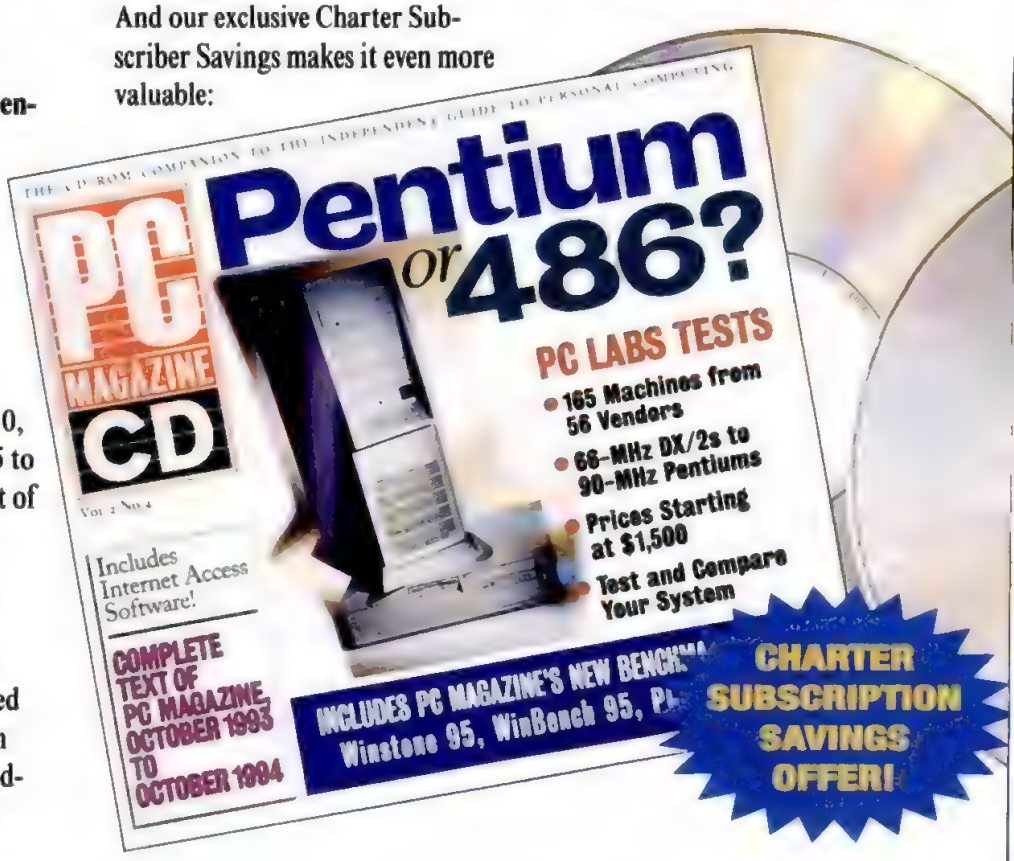

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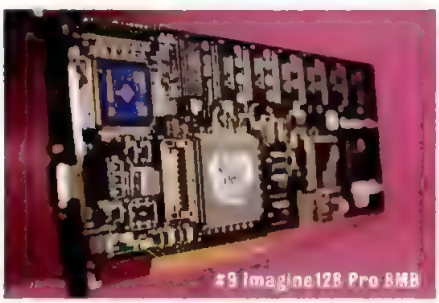
of the usual GUI features built into its core, including the ability to perform BitBlts, line draws, and pattern fills. What's missing is the video acceleration built into the Vision 968.

The 220-MHz Texas Instruments RAMDAC and 4MB of VRAM combine nicely with the S3 Vision 964 to deliver above-average refresh rates of 120 MHz at 1,024-by-768 at 24-bit color and 76 Hz at both 1,280-by-1,024 and 1,600-by-1,200 resolutions with 16-bit color.

The muscle behind the #9GXE64 Pro's impressive AutoCAD performance could well lie in its Number Nine–engineered PowerPac drivers. Where virtually every other card we saw came with a version of Panacea's TurboDLD drivers, the PowerPac suite leverages Number Nine's long experience with CAD. That the drivers make most of the difference in CAD performance is borne out by the card's poor performance on our Vector File Open tests: Here, the #9GXE64 Pro limped into a tie for last place.

Windows graphics performance was a strangely mixed bag. Though the #9GXE64 Pro garnered squarely average marks for true-color 1,024-by-7,68 performance on the Winstone 95 and Graphics WinMark 95 tests, it shot up to third place on the Raster Rotate test at the same resolution and color depth. Interestingly, the #9GXE64 Pro outpaced Number Nine's Motion771 on our applications-based Winstone tests but was in turn bested by the Motion771 on the Graphics WinMark tests. These results would seem to indicate that the #9GXE64 Pro fares slightly better on real-world Windows tasks than the Motion771.

Like the other Number Nine offerings, the #9GXE64 Pro comes with DCI drivers and the stellar HawkEye for Windows utilities. Like the Motion771, the #9GXE64 Pro's version of HawkEye adds a monitor-selection utility and settings to fine-tune Windows drivers. One caveat: We found that if you select a monitor definition that's not identical to your monitor, you may be unable to display some resolutions. Setting up a custom monitor definition solved the problem, however.


#9 Imagine128 Pro 8MB

The #9GXE64 Pro 1600 PCI has its moments. But when you consider the card's $799 price tag, lackluster performance, and lack of innovative features, you may find that there are just too many alternatives in the pantheon of graphics powerhouses to justify the buy.

#9GXE64 Pro 1600 PCI. *Estimated street price: $799. Number Nine Visual Technology Corp., 18 Hartwell Ave., Lexington, MA 02173; 800-438-6163, 617-674-0009; fax, 617-674-2919.*

Circle 461 on reader service card

Number Nine Visual Technology Corp.

#9 Imagine128/1600
#9 Imagine128 Pro 8MB

BY DAVID A. HARVEY

PC MAGAZINE EDITORS' CHOICE

These cards both combine ultra-fast 128-bit graphics accelerators, screaming refresh rates, and tremendous utilities into potent packages aimed at the graphics professional.

The #9 Imagine128 Pro 8MB, our Editors' Choice, scorched a path through the upper ranks of our tests. Impressively, its performance was consistent between our low-level and applications-based benchmark tests. The only question mark concerning its performance is in DOS AutoCAD: Drivers were not available in time for our testing.

In contrast, the 4MB #9 Imagine128/1600 fared impressively but unevenly. It bested the Imagine128 Pro 8MB on both our Vector File Open and 1,600-by-1,200, 16-bit color Graphics WinMark 95 tests; it also turned in strong AutoCAD scores. But it does not support 24-bit color at 1,280-by-1,024 resolution, and it turned in less than admirable results on our Raster Rotate test.

The $1,999 Imagine128 Pro 8MB, one of only two 8MB cards in this roundup, is significantly more expensive than the $1,199 Imagine128/1600. But graphics professionals will clearly be better served by the more expensive version of this card.

The only 128-bit accelerator on the market, the Imagine128 chip can process a whopping four 32-bit chunks of true-color data at a time. Drop down to 16-bit mode and the chip blasts eight 2-byte chunks at once; at 8-bit resolution, you get an incredible 16 chunks of 8-bit color data per clock cycle. Internally the chip has 128-bit pathways to its multiaperture and memory controllers. It communicates with the outside world via 128-bit pathways to the RAMDAC and VRAM, a 32-bit path to the PCI interface, and a 16- or 8-bit path to its mask buffer.

In addition to raw bandwidth, Number Nine packs a stolid assortment of features into its Imagine128 chip. It supports all the usual GUI functions, including BitBlt acceleration, pattern line drawing, and text and rectangular clipping. Unique to the Imagine128 are a triple-buffered memory architecture, an internal 1K double-buffered cache, and a port to a DRAM mask buffer for advanced clipping and video applications.

In true-color mode, the Imagine128 Pro 8MB claims a whopping 185-Hz refresh at 1,024-by-768 resolution (our test monitors, arguably the best available, cannot scan above 120 Hz, so we were not able to confirm this). At 1,280-by-1,024 resolution, it delivers a rock-steady 112 Hz; at 1,600-by-1,200, it delivers a pedestrian 72 Hz—the only relative weakness of this otherwise stellar refresh performer. The Imagine128/ 1600 delivers an admirable 185 Hz at 1,024-by-768, its highest true-color resolution. Drop the pixel depth and refresh goes off the scale—if your monitor can handle it.

SUITABILITY TO TASK

#9 Imagine128 Pro 8MB	
Raster graphics	Excellent
Vector graphics	Fair
CAD	N/A
Mainstream usability	Excellent

HAWKEYE UTILITY SUITE

Number Nine's HawkEye for Windows is an impressive suite of graphics enhancements designed to make life easier for the professional. The HawkEye utilities include Hot Mouse, Resolution Exchange, Place Windows, Stop Box, Zoom, Chameleon Cursor, Monitor Adjustment, Color Perfect, Energy Saver, and #9 Status.

Hot Mouse lets you assign any of the HawkEye features to a combination of keystrokes and mouse buttons or simply

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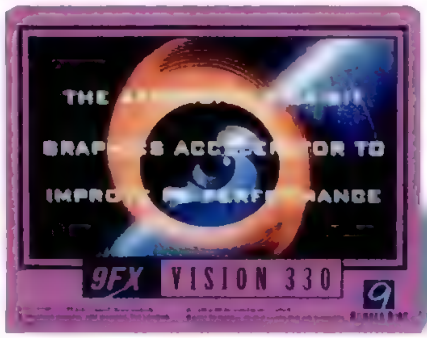

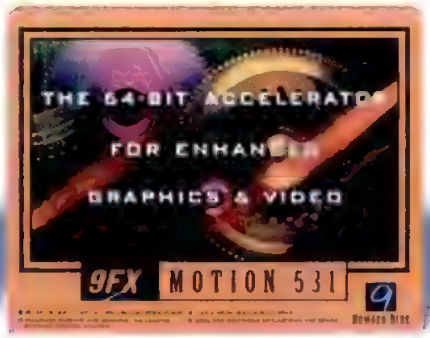

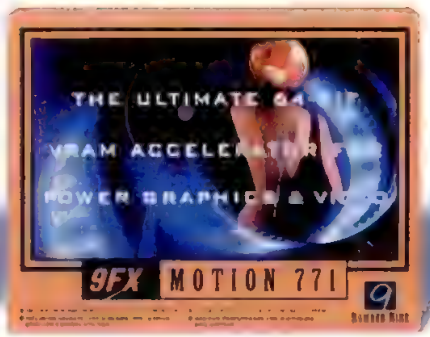

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CIRCLE 259 ON READER SERVICE CARD

Accelerated Video: *Now Premiering*

By Jan Ozer

As professional-level graphics cards reach ever greater heights of power, new hardware video-playback technologies are appearing that will affect the entire spectrum of the graphics-card market. A host of new video-capable graphics chips are here today, and the next generation of graphics adapters with vastly improved video features is just around the corner.

All share a common goal—bringing smooth, full-screen video scaling and 30-frame-per-second playback with good color fidelity to compressed video formats like Indeo, Cinepak, or MPEG. While it's still too early to pick the ultimate winners, the direction this next wave is taking is already clear.

DITHER THOU GOEST

Today, when 24-bit codecs like Indeo and Cinepak display in 8-bit color mode, they reduce color depth to the required 256 colors and then *dither*, a process that creates small geometric patterns to smooth transitions between two colors. While this improves the appearance of the video image, quality is clearly far short of 24-bit color.

Three new hardware-based approaches address the limits of software-based dithering. The first approach uses sophisticated dithering engines in the controller hardware in place of the dithering normally performed by the codec. This attempts to simulate 16- or 24-bit color quality in the 8-bit stream.

In most implementations, the native YUV video data (which defines color in terms of chrominance and luminance) is dithered during conversion to the PC's RGB format before it is moved into the frame buffer. Once there, the video is scaled to final output resolution. While this doesn't yield 24-bit video quality, it improves on codec-based dithering and video can be displayed at 1,024-by-768 resolution in 8-bit color with only 1MB of video RAM.

The second approach is to store the video in the frame buffer's off-screen video memory in YUV mode, then convert the video to RGB, scale if necessary, and overlay the video on top of the graphics data during transfer to the DAC. Since video and graphics data are stored separately, the video can be displayed in true rather than simulated 24-bit color, even when the graphics are set at 8- or 16-bit mode. Scaling to higher resolutions can occur within the off-screen frame buffer, which increases video RAM requirements, or after the video data is transferred to the DAC. The obvious advantage of maintaining video in YUV space is better-looking video.

A third option is to use a ZoomDAC, which dithers and scales video in the RAMDAC right before video is sent to the monitor. While dithering in the ZoomDAC won't match true 24-bit color, the quality should exceed that of video dithered inside the frame buffer, which is always limited to 256 colors in 8-bit mode.

SMOOTH SCALING

All video coprocessing chips scale video to larger resolutions using some form of filtering to smooth the display. How well the chips manage this process has a profound impact on both video quality and display rate.

SUMMARY OF FEATURES

Video-Enabled Chips

■ YES ■ NO
In alphabetical order by company

	Advance Logic Inc. **ALG 1301 Video Wizard**	ATI Technologies Inc. **Mach64**	BrookTree Corp. **BtV Media-Stream**	Digital Equipment Corp. **DECchip 21130**	I.C. Works Inc. **ZoomDAC**	Matrox Graphics Inc. **MGA-2064W**
Function	ZoomDAC	Controller, scaler, DAC	Controller, scaler	Controller, scaler, DAC	ZoomDAC	Controller, scaler
Dithering	N/A	■	■	■	N/A	■
Width of data path	32-bit	64-bit	32-bit	64-bit	64-bit	64-bit
Scaling methods:						
Horizontal (x-axis)	Interpolation	Interpolation	2-tap	3-tap	4-tap	Interpolation, pixel replication
Vertical (y-axis)	Interpolation	Interpolation	2-tap	Line replication	4-tap	Line replication
YUV-to-RGB conversion	■	■	■	■	■	■
Memory type	Depends on controller	DRAM, DRAM EDO	VRAM	DRAM EDO	Depends on controller	WRAM
Maximum	Varies	4MB	4MB	4MB	Varies	8MB
DCI	■	■	■	■	■	■

N/A Not applicable The product does not have this feature

The most basic form of scaling is *replication*, where a single pixel or line of pixels is reproduced in the number required to fill the larger resolution. Scaling from 320-by-240 to 640-by-480, for example, increases the area fourfold, so each single pixel is converted into a four-pixel block.

Interpolation, or pixel averaging, is the next level of smoothing. The formula, adding the values of adjacent pixels and dividing by two, makes interpolation inexpensive to implement. All the chips listed below interpolate on the *x* axis. The more cost-conscious producers interpolate in the *x* axis and use pixel replication in the *y* axis. The most sophisticated filter both axes. Filtering is described in *tap values*, which describe how many pixels surrounding the target pixel are considered during filtering.

Chips vary by the formats they can scale. The most common approach is to scale codecs including Indeo, Cinepak, and most software MPEG products, but older codecs such as Video1, found in some older CD-ROM titles, may be excluded.

HARDWARE ARCHITECTURES

Currently, we're seeing three strategies for putting video acceleration on your graphics card. The first is an integrated controller/accelerator, which integrates video acceleration into the base video controller chip set. Because most controllers are targeted toward the mass market, video acceleration competes with more mainstream graphics features for real estate on the chip die and must be inexpensive to implement. This is why pixel replication is a popular scaling strategy for producers of low-cost chips such as Digital Equipment and Western Digital.

The second architecture uses a separate video coprocessor chip. Since these chips are typically designed for products targeted toward video consumers, performance rather than price is the key issue. Recognizing that a separate video accelerator will outperform an integrated controller/accelerator, S3 offers an integrated chip for mass-market products as well as a standalone video accelerator for high-end video applications.

As we've seen, the third approach is the ZoomDAC, which in some ways represents the best of both worlds. Less expensive than a separate accelerator, ZoomDACs aren't subject to the same real estate or cost limitations as the integrated controller/accelerator, enabling more robust and sophisticated filtering features.

S3 Inc. **S3 Vision 968**	S3 Inc. **S3 Vision/VA**	Tseng Labs Inc. **VIPeR f/x**	VideoLogic Inc. **PowerPlay 64**	Weitek Corp. **Video Power**	Western Digital Corp. **WD9710**
Controller, scaler	Scaler	Scaler	Scaler	Scaler	Controller, scaler, DAC
■	■	■	■	■	
64-bit	32-bit	16-bit multiplexed	64-bit	32-bit	64-bit
5-tap	5-tap	64-tap	Multitap	4-tap	4-tap
5-tap, line replication	5-tap, line replication	64-tap	Multitap	2-tap	Line replication
■	■	■	■	■	■
DRAM, VRAM	Depends on controller	DRAM	Depends on controller	VRAM	DRAM
DRAM, 4MB; VRAM, 8MB	Varies	4MB	Varies	4MB	4MB
■	■	■	■	■	■

ANECDOTAL TESTING

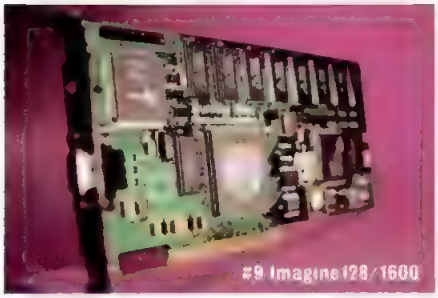
We looked at three cards with video playback support that illustrate these three approaches: Number Nine Visual Technology Corp.'s #9FX Motion771 ($599), built around the S3 Vision 968 controller/accelerator; Diamond Multimedia Systems' Viper Pro Video ($649), equipped with Weitek Corp.'s separate Power Video accelerator chip; and Hercules Computer Technology's Stingray 64 ($250), which uses I.C. Works' ZoomDAC. (Boards using video overlay rather than a dithering engine were not available for testing, so we could not informally test the difference between these two techniques.)

First, we tried video playback in 8-bit graphics mode, checking visually to judge the quality of the various dithering schemes. Then we bumped color depth up to 24 bits while scaling a 160-by-120, 30-frame-per-second (fps) file to 640-by-480 resolution. Here, we checked both appearance and the card's ability to scale without reducing display rate. We checked for these again with our final test, also performed at 24-bit color depth but involving 2x scaling of a 320- by 240-pixel, 30-fps file.

Results of the first test demonstrated that video displayed in 8-bit mode will appear dithered irrespective of dithering scheme and may never match true 24-bit color in terms of quality. No big surprise. Results of the second and third tests showed that from a pure horsepower standpoint, separate accelerator chips or ZoomDACs outperform integrated controller/accelerator chips.

The limited nature of these tests minimizes the value of any sweeping conclusions. But all three approaches are clearly a vast improvement over non-accelerated technologies from both a quality and display-rate standpoint. This bodes very well for the continued integration of high-quality video into graphics hardware, a trend we expect will become a stampede over the next half year. □

to keystrokes. Resolution Exchange is a graphical utility that lets you change resolution and color depth and specify virtual-desktop settings.


#9 Imagine128/1600

Place Windows and Stop Box are enhancements for Number Nine's unique virtual-desktop features. Zoom lets you configure multiple hardware zoom levels. Chameleon Cursor lets you adjust the size and color of your cursor. Color Perfect is a sophisticated gamma-correction utility.

Though not as precise as hardware color-correction utilities, Color Perfect is as accurate as your eye and lets you tune your spectrum using either RGB or CMYK color models. Monitor Adjustment is the control center for the Imagine128's stellar refresh rates. Here you can fine-tune your refresh rate by clicking on arrows and running a 5-second test of the new rate. If your monitor doesn't support it, you'll be back at your old rate after the test with no harm done.

SUITABILITY TO TASK	
#9 Imagine128/1600	
Raster graphics	Fair
Vector graphics	Excellent
CAD	Good
Mainstream usability	Excellent

Energy Saver lets you configure Energy Star–compliant power-down modes. With a Nanao FX2-21 Energy Star–compliant monitor, the Energy Saver feature worked flawlessly. The #9 Status utility gives you the lowdown on your card, from the amount of memory installed to driver and BIOS versions. This utility is designed to make any calls you might have to make to tech support far easier.

For those whose days are spent working with raster images, there's a near-instantaneous hardware zoom that, depending on resolution and color-depth, ranges from 2 to 16 levels of magnification. One problem we noted, possibly driver-related, was that the Imagine128 Pro 8MB did not have as many zoom levels as its 4MB sibling. For example, the Imagine128/1600 delivers 2x, 4x, 8x, and 16x zoom at 32-bit true-color resolutions of 1,024-by-768 and 1,152-by-864. The better-equipped Imagine128 Pro 8MB, on the other hand, provides a paltry 2x zoom at those resolutions and color depths.

HawkEye's slickest trick is unquestionably its virtual-desktop features. Rather than leaving you floating uncontrolled around a double-width desktop, the Stop Box and Place Windows utilities let you control how applications and their dialogs pop onto the screen. Stop Box allows you to center the display on the nonvirtual area of the screen, letting you have multiple applications tiled on your virtual workspace. Place Windows designates whether dialog boxes pop up in the center of the virtual or physical screen.

The Imagine128/1600 is a worthy contender aimed more at those who don't need true-color resolutions above 1,024-by-768. Fast and impressively designed, the Imagine128 Pro 8MB offers a compelling combination of beauty and brawn aimed at the needs of the demanding image-editing professional.

#9 Imagine128/1600. *Estimated street price: $1,199.* **#9 Imagine128 Pro 8MB.** *Estimated street price: $1,999. Number Nine Visual Technology Corp., 18 Hartwell Ave., Lexington, MA 02173; 800-438-6163, 617-674-0009; fax, 617-674-2919.*

Circle 461 on reader service card

rPC, a division of Radius Inc.

FireStorm 192

By John R. Quain

When you're shopping for an interview suit, your best bet is a classic style in a solid color. DTP professionals who similarly favor reliability over hot trends will appreciate the $999 FireStorm 192 for its stability, respectable performance, and fine tailoring. Its hardware is almost identical to that of the UMAX Maxmedia CX/Pro, also in this roundup. What sets it apart is Radius's experience in the Macintosh DTP world, demonstrated by its convenient and powerful DTP utilities.

The FireStorm 192 is one of the few graphics cards we saw that could manage a 1,600-by-1,200 display in 24-bit color mode without resorting to pixel packing. The card will display 16.7 million colors at a flicker-free 120-Hz vertical refresh rate in 1,024-by-768 mode. True-color refresh rate in 1,280-by-1,024 is an ergonomic 85 Hz, but unfortunately the rate drops to only 66 Hz in 24-bit color mode at 1,600-by-1,200.

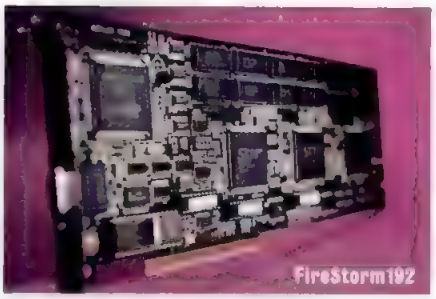
To get true color at these resolutions, the FireStorm 192 employs an unusual design. It uses three S3 Vision 864 chips in lieu of a single controller. Each is responsible for a single color (red, green, or blue) and is connected to three 2MB banks of DRAM for a total of 6MB of memory. Each memory path is 64 bits wide, thus creating a total data path of 192 bits. On the other side, each 64-bit S3 graphics engine is connected to a synchronizer in 16-bit wide paths and then to a Texas Instruments PTVP3026 175-MHz RAMDAC. For raw BitBlt power, this is an effective design, although the controllers lack such advanced features as hardware 3-D and digital video acceleration.

On our applications-based Winstone 95 tests using 1,024-by-768 resolution and 16.7 million colors, the FireStorm 192 offered above-average performance, coming in fifth out of 16 cards. On our Graphics WinMark 95 tests in 1,280-by-1,024 mode with 24-bit color, the FireStorm 192 came in fourth but fell substantially behind the top three performers. The overall results, however, still promise high-level Windows performance. On our demanding Vector File Open test, the FireStorm 192 proved to be an average performer. Raster Rotate test results were above average. Serious CAD users won't be as excited, however: AutoCAD performance was average to well below average.

Installing the FireStorm 192 is simple and foolproof. The software tells you exactly what is being installed—and where. The ControlDesk utility lets you change color depth, resolution, and refresh rates as well as adjust pan and zoom, change DPMS settings, and set up virtual-display sizes. The zoom feature is particularly sharp and proved handy for checking work on a pixel-by-pixel level.

The most helpful utility for professionals is ColorComposer, a Windows version of Radius's popular Macintosh software. ColorComposer makes the FireStorm one of the only cards that offers features considered mandatory by graphics profession-

als. It's one of the best utilities for color calibration and lets you adjust the display's white point, midrange colors, and contrast. It also offers helpful tips about the relationship between the display's RGB image and CMYK printouts. For those proofing film, there's a toggle to switch between a positive and negative view. And the fastidious can tweak gamma curves.



The FireStorm 192 is a very stable performer, able to handle concurrent Windows and DOS applications without a hiccup—even while connected to a network and running its own virtual desktop. Buyers should note that the FireStorm 192 will use the S3 Vision 868 graphics accelerator chip starting this summer when S3 discontinues the Vision 864 chips.

SUITABILITY TO TASK	
FireStorm 192	
Raster graphics	Excellent
Vector graphics	Good
CAD	Fair
Mainstream usability	Excellent

FireStorm 192. *List price: $999. rPC, a division of Radius Inc., 215 Moffett Park Dr., Sunnyvale, CA 94089; 800-459-4772, 408-541-5400; fax, 408-541-5816.*

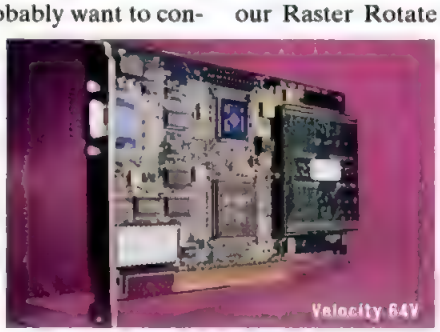
Circle 462 on reader service card

STB Systems Inc.

Velocity 64V

BY JOHN R. QUAIN

STB Systems' Velocity 64V is a more-than-able Windows performer, and with a list price of $449, it's hundreds of dollars less expensive than most cards in this roundup. It lacks some professional amenities, such as the ability to handle 24-bit images at its top resolution of 1,600 by 1,200 pixels, but it still offers a respectable platform for true-color graphics in resolutions up to 1,280 by 1,024 pixels. Professionals will probably want to consider a faster, more feature-packed card, but for high-end business applications supplemented by some color work, the Velocity is an attractive choice.



Outfitted with 4MB of EDO (extended data out) VRAM that gives it faster memory-to-controller performance, the Velocity is one of six cards we reviewed based on the popular S3 Vision 968 graphics accelerator chip. This 64-bit graphics engine features a full set of the standard Windows acceleration functions plus hardware acceleration for scaling digital video in Cinepak, Indeo, and Video for Windows formats.

The Velocity's refresh capabilities, provided by IBM's 220-MHz RGB524 RAMDAC, are thoroughly respectable if not quite stratospheric. It can manage an ergonomic 80-Hz refresh rate in 16-bit color mode at 1,600 by 1,200 pixels, and in true-color 1,280-by-1,024 mode it runs at 85 Hz. Lower resolutions with 24-bit color depths can be pushed to a nearly flicker-free vertical refresh rate of 100 Hz.

The STB card delivered respectable Windows acceleration as well. Although it performed slightly below average on our applications-based Winstone 95 tests, it achieved better results than some higher-priced cards, including the MGA Impression Plus cards. Running in 16-bit color mode at 1,600-by-1,200 pixels, it placed in the middle of the pack on our Graphics WinMark 95 tests. Boosting the color depth hurt performance, cutting the Velocity's ranking at 1,200-by-1,204 resolution to near the bottom of the heap.

SUITABILITY TO TASK	
Velocity 64V	
Raster graphics	Excellent
Vector graphics	Excellent
CAD	N/A
Mainstream usability	Good

In handling standard vector drawings, the card proved as adept as the leaders. Photoshop users will note, however, that it dropped to the middle of the lineup on our Raster Rotate test. Unfortunately, AutoCAD drivers did not arrive in time for our tests; the company claims that they will be available by the time you read this.

In hands-on tests, we found STB's bundled software controls adequate to most tasks. The installation routine is fairly straightforward and offers a list of over 300 predefined monitor setups, so you don't need to spend time playing with refresh rates and resolutions. A group of icons lets you switch Windows resolutions on the fly.

In addition to the standard suite of bird's-eye zoom and DPMS controls, STB includes ColorIt with the Velocity. ColorIt lets you adjust RGB levels, brightness, contrast, and color temperature. It also contains a handy list of settings to adjust your display automatically to match the lighting conditions in your work space. Unfortunately, conducting precise gamma correction with ColorIt is a tricky process: If you want a specific setup, you need know exactly what numerical values to enter.

One other notable software feature is STB's multiple-desktop utility, which lets you hide applications on different virtual screens. You can save, say, Program Manager on an 800-by-600, 256-color screen and Photoshop on a 1,280-by-1,024, 24-bit color screen. When you switch between desktops, the resolution and color depth change automatically. The only danger is forgetting where your application is.

To those looking only for an inexpensive Windows hot rod that can double as a part-time 24-bit graphics vehicle, the Velocity 64V has several points in its favor. Those who want more should spend more money on one of the faster 24-bit color performers in this roundup.

Velocity 64V. *List price: $449. STB Systems Inc., 1651 North Glenville, P.O. Box 850957, Richardson, TX 75085; 800-234-4334, 214-234-8750; fax, 214-234-1306.*

Circle 463 on reader service card

UMAX Technologies Inc.

Maxmedia CX/Pro

BY JONATHAN HILL

Bucking an industry trend toward increasing miniaturization and integration, UMAX Technologies' Maxmedia CX/Pro ($1,299) is a full-featured, full-length card that relies on three S3 Vision 864 graphics accelerator chips to provide exceptional performance

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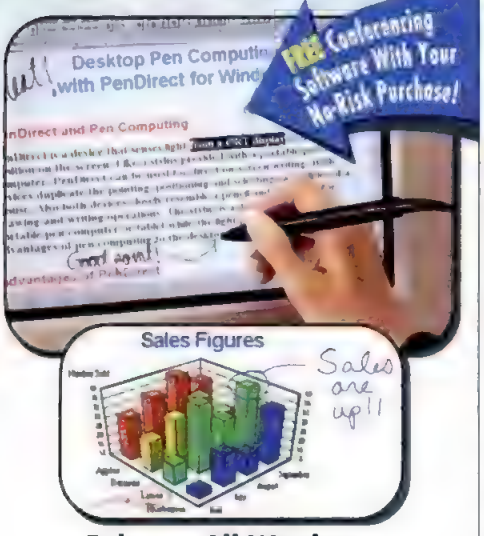

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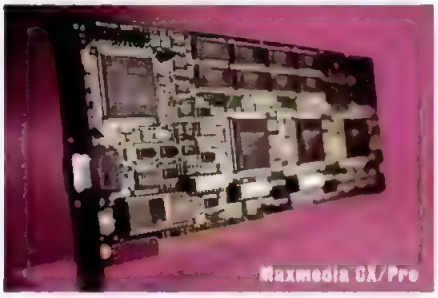
with true-color raster images. In 24-bit mode, each S3 Vision 864 chip provides dedicated processing for each color (red, green, or blue) using three separate 2MB banks of DRAM to maintain a 192-bit pathway to its TI PTVP3026 175-MHz RAMDAC. As a result, the Maxmedia is one of the fastest cards on the market today at moving 24-bit image data from memory to the screen. Such operations are critical for desktop publishing and image processing, the intended uses of this card.


Maxmedia CX/Pro

In 8-bit color, two of the S3 Vision 864 chips are disabled, and the card functions like any other midrange DRAM-based accelerator. So unless you spend most of your time in true color, you'd be better off saving the nearly $1,000 difference between such cards and the Maxmedia (which does not support 16-bit color).

The Maxmedia performs adequately on mainstream business applications, but the key to its allure is its ability to move the huge volumes of data that high-resolution, 24-bit color imaging requires. The card is unique in that there is literally no drop-off in performance between 8-bit and 24-bit modes, even though the latter requires three times the bandwidth.

Keeping the three main chips in line is the key hurdle that UMAX engineers have overcome in the Maxmedia. Expecting to find color-coordination problems, we tested the card exhaustively in 24-bit color mode at a resolution of 1,600 by 1,200 pixels, but we found no untoward effects—indicating that UMAX has done a good job of resolving the potential for timing errors. The company claims that occasional wait states are inserted in its processor cycles to let the card synchronize properly, but its Graphics WinMark 95 performance indicates that these have had no significant impact on the S3 Vision 864 chips' ability to process graphics.

With separate memory paths for each color channel, the card manages to overcome DRAM-based products' usual problems in maintaining a high screen-refresh rate, but the 175-MHz RAMDAC is a bit overwhelmed at its maximum resolution of 1,600 by 1,200 pixels in 24-bit color. At this resolution, we could coax only a 66-Hz vertical refresh rate out of the card, less than optimal when viewed on a 21-inch monitor. In 24-bit color at a resolution of 1,280-by-1,024 pixels, the Maxmedia was able to hold a vertical refresh rate of 80 Hz—sufficient to eliminate screen flicker on large monitors.

Installation using the Maxmedia's DOS-based installation program was smooth and uneventful. We set the resolution, refresh rate, and color depth with UMAX's Video Panel Windows utility. The Maxmedia utilities include a virtual desktop, hotkey access to pan and zoom, a spyglass or bird's-eye zoom, and monitor-adjustment test screens. The card's Monitor Calibration utility is among the best we've seen, with capabilities far beyond those of typical bundled utilities that merely let you play with RGB gamma curves. It allows detailed color calibration with an eye towards DTP parameters such as color temperature, phosphor type, and gamma correction for different types of room lighting. You can use Monitor Calibration's GrayRamp target image and RGB Trim controls to coordinate printed and monitor images.

Below its maximum resolution of 1,600 by 1,200 pixels, the Maxmedia CX/Pro was a lackluster performer on our Graphics WinMark tests. But it shone on our custom Raster Rotate and Vector File Open tests, consistently finishing near the top of the heap. Though obviously not intended for casual mainstream users, it is very well suited for high-resolution imaging work. □

SUITABILITY TO TASK

Maxmedia CX/Pro	
Raster graphics	Excellent
Vector graphics	Good
CAD	N/A
Mainstream usability	Good

Maxmedia CX/Pro. *List price: $1,299. UMAX Technologies Inc., 3353 Gateway Blvd., Fremont, CA 94538; 800-562-0311, 510-651-9488; fax, 510-651-8834.*

Circle 464 on reader service card

OS/2's High Performance File System overcomes most of the limitations of the FAT file system used by DOS and Windows 3.x. To find out how it accomplishes this, see this issue's Tech Notes column by Brian Proffit.

User-to-User

BY NEIL J. RUBENKING

Building a Bigger Environment

Do you ever get "Out of Environment Space" messages when a second copy of COMMAND.COM is loaded, perhaps when running DOS under Windows or when you've shelled out of a program? The problem lies in the skimpy default size of the environment. In DOS 5.x and DOS 6.0, the environment is only 256 bytes. In DOS 6.22, it's 272 bytes. You can alter the size of the environment for the primary command processor using the SHELL= command with the /E: switch in your CONFIG.SYS file, but that doesn't help when a secondary command processor is loaded. The solution is to patch COMMAND.COM to increase the default size of the environment. A warning, though: Never patch your original COMMAND .COM. Instead, system-format a floppy disk and work on its copy of COMMAND.COM. When you're satisfied that version works, copy it to your hard disk.

I used DEBUG's unassemble command to find the following line:

```
xxxx:1773 C7068D211000
 MOV WORD PTR [218D],0010
```

This places the size of the environment at offset 1777. Changing the 10 to 40 will increase the size of the environment to 1,040 bytes. After you load COMMAND.COM into DEBUG, the following commands will display the contents of address 1777, change the contents of address 1777 to 40h, write the change to disk, and quit:

```
D 1777 L 1
E 1777 40
W
Q
```

If the first command (the one that begins with the letter D) does not display 10, quit immediately without making any changes.

The address to use for DOS 5.0 is 1666; for DOS 6.0, it's 1767. Just substitute this address for 1777 in the DEBUG instructions above. And if you use a hex editor rather than DEBUG, remember that offset 1777 in DEBUG is really byte 1677 from the beginning of the file, since DEBUG starts counting at 100. So if you're using a hex editor, byte 1677 is the one to change.

Mark Naidorf
via ZiffNet

▶**PC MAGAZINE:** For DOS 6.2, the address of the byte to change is 1777—the same as DOS 6.22. But I can't emphasize enough that you must stop after entering the D command and be sure that the byte displayed is 10. If it's not, just give the Q command right away, because for whatever reason your copy of COMMAND .COM is not precisely the same as the version we examined.

How can you be absolutely sure the patch worked? You can make this test before you install the patched COMMAND.COM: Enter COMMAND at the DOS prompt to start a secondary command processor, and then enter the following:

```
MEM /D | FIND "COMMAND" | FIND
 "Environment"
```

The output should contain two lines, something like this:

```
005FE 1,040 (1K) COMMAND Environment
01693 272   (0K) COMMAND Environment
```

The first line is the environment of the primary command processor loaded at startup. In this case, a SHELL= line in CONFIG.SYS expanded the environment. The second line is the environment of the secondary command processor; as expected, its size is a mere 272 bytes. (If you're running DOS 5.0, use /P instead of /D in the MEM command; the resulting lines will display the environment size in hexadecimal rather than decimal.)

Now store a copy of the unpatched COMMAND.COM, copy the patched version over it, and reboot. Repeat the test described in the preceding paragraph. You should find that the secondary command processor has an environment size of 1,040 bytes.

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Easier User Input With the FC Command

The conventional wisdom says that DOS is dead, or at least dying, but many of us still use a lot of DOS applications. So I keep working with batch files, to make DOS easier.

In that vein, I recently stumbled onto a gold mine of new functionality in a very unlikely place—the FC.EXE (file compare) program. Though I had found little use for FC in the past, I've discovered it can be used in ways that the developer probably never envisioned to perform a variety of different tasks. One such task is dealing with data entry from the keyboard.

The secret to using FC to input data from the keyboard is to compare two standard system devices, CON and NUL. The CON device captures the user's keystrokes (as with the previously documented COPY CON... approach). The difference is that FC has a switch (/LBn) that controls the length of an internal line buffer. When the line buffer is set to one, the process is terminated at the end of the first line that is different. This happens upon pressing the Enter key when the CON input is compared to NUL. Thus the user does not need to be prompted to press Ctrl-Z, nor does the ANSI.SYS driver need to be loaded to allow redefinition of the Enter key to provide that character.

Simply CALL the batch file shown in Figure 1 and the line typed by the user will be returned in the environment variable MInput. All the standard DOS edit keys can be used while entering input, which means they cannot be made part of the input string. That is, this approach will not return the Esc key or the Backspace, for example. Likewise, the standard DOS delimiters (comma, semicolon, equal, and tab) act as delimiters in the input string and are not returned. Redirection characters (<, >, and |) must not be used, as they will cause errors or erratic behavior.

Note the use of the DATE function to append the output of the FC command to an ASCII string. This permits the input data to be processed by the ENTER .BAT file that is constructed by INPUT.BAT. ENTER.BAT is invoked by the CALL to the EN#ER.BAT file. In general, one line from the redirected output of any process can be handled this way. The redirected input must end in a blank line to terminate the DATE command, or the whole process will hang up. Luckily, the FC command adds two blank lines to its output.

Finally, a note of explanation: You probably noticed the unconventional placement of the file redirection symbols at the beginning of batch lines. I found that DOS doesn't care, and it's better for debugging to put the redirection symbols there so the file names and the executable parts of the lines will align properly.

```
@ECHO OFF
REM INPUT.BAT - Returns a line of user input in
REM   environment variable MInput
> EN#ER.BAT  FC CON NUL /LB1 /N | DATE | FIND "    1:  "

> ENTER.BAT  ECHO SET MInput=
>>ENTER.BAT  ECHO :Loop
>>ENTER.BAT  ECHO IF NOT '%%MInput%%'==''' SET MInput=%%MInput%% %%5
>>ENTER.BAT  ECHO IF '%%MInput%%'==''' SET MInput=%%5
>>ENTER.BAT  ECHO SHIFT
>>ENTER.BAT  ECHO IF NOT '%%5'==''' GOTO Loop

CALL EN#ER.BAT
DEL EN?ER.BAT
```

Figure 1: **INPUT.BAT uses an unusual assortment of DOS commands to take a line of input from the user. The standard DOS edit keys must not be made part of the input string.**

Thomas G. Lavedas
Clifton, Virginia

►PC MAGAZINE: The original INPUT .BAT used a DEBUG script to present a prompt and take the user's input on the same line as the prompt. It also stored each word of user input in a separate environment variable. I trimmed the batch file down for reasons of size and complexity. The version that remains still admirably demonstrates the technique of using FC to process a string of user input.

Let's break down the most important command line in INPUT.BAT. The first thing that happens is the command

```
FC CON NUL /LB1 /N
```

This tells FC to compare the user's input with the NUL device, stopping after one mismatched line (/LB1), and prefixing each line with its line number (/N). If the user entered `DOS is not dead`, the output of this command would look like:

```
Comparing files CON and NUL
DOS is not dead
Resync failed. Files are too different
***** CON
1: DOS is not dead
***** NUL
*****
```

These seven lines are redirected as input to the DATE command. None of them is a valid date, so for each line DATE responds with a message like:

```
Invalid date
Enter new date (mm-dd-yy):
   1: DOS is not dead
```

These lines are redirected in turn through the FIND filter, which selects only the line that contains the string "1:". Finally, this single line is stored in the file EN#ER.BAT. When this batch file is CALLed by INPUT.BAT, it (EN#ER.BAT) in turn executes ENTER .BAT, passing the user's input in command line parameters starting with %5. ENTER.BAT combines the separate words into the single environment variable MInput.

This may seem like a lot of work just to get a line of input from the user, but it's an improvement over all previous input solutions. This technique doesn't require you to keep a special data file on hand, doesn't force the user to press Ctrl-Z to end input, and doesn't need ANSI.SYS—just to name a few of its advantages. □

Tutor

BY JEFF PROSISE

Drive Size vs. Storage Efficiency

You just brought home that new 1GB hard disk and installed it in your PC. You start good old FDISK—DOS's hard-disk partitioning utility—and prepare to partition the drive. Immediately you are confronted with a decision: Should you configure the entire disk as one large partition, or should you divide it into two or more logical DOS drives?

This is not a decision to be taken lightly. Believe it or not, the partition size (or sizes) that you choose could have a dramatic impact on your hard disk's overall storage efficiency. Because the FAT file system used by DOS allocates disk space in *clusters* of a set size, there is wasted space on every drive. On a drive with 2K clusters, a file 1 byte long requires 2K of disk space; the same file requires 4K on a drive with 4K clusters, and so on. The empty space between the end of a file and the end of the cluster that contains that part of the file is called *cluster overhang* (see Figure 1). The greater the cumulative cluster overhang (the combined overhang of all files), the greater the amount of wasted space on the drive.

How does this relate to partition size? When you format a drive with DOS's FORMAT command, FORMAT picks the smallest cluster size possible based on the size of the logical drive. The fact that FAT entries are only 16 bits in length means that there can't be more than 65,536 clusters on the drive. A 2K cluster size limits the drive to 128MB. FORMAT bumps up the cluster size as the drive size increases to make up for this limitation in the file system.

Therefore, the larger the partition size, the greater the cluster size—as the table in Figure 2 shows. The cluster size on a 520MB drive (16K) is eight times that of a 120MB drive (2K). This means that, on the average, you lose 8K of disk space for every file on a 520MB drive, but only 1K on a 120MB drive. The average overhang equals about half the cluster size if the drive contains a large number of arbitrarily sized files, because the amount of data in a file's final cluster can range from 1 byte to the full size of the cluster; half the difference is very close to half of the cluster size.

Nominally, this would indicate that smaller cluster sizes are better. But there's more to it than that. Theoretically, some of the losses resulting from large cluster sizes are offset by the reduced number of file allocation table (FAT) entries required to record the locations of large files. Take a 2,053K file, for example. On a drive with a 2K cluster size, that file requires 1,027 clusters and therefore 1,027 FAT entries. Since FAT entries are 2 bytes long for any drive with a capacity greater than 16MB, a 2,053K file requires 2,054 bytes of space in the FAT. So in addition to the 1K of space lost to cluster overhang, you lose another 2K to FAT entries.

On a drive that uses 8K clusters, the overhang is 3K, but the number of FAT entries required drops to 257, reducing the FAT space used by the file to just 514 bytes. The saving in FAT space almost makes up for the loss due to cluster overhang. If your hard disk contains primarily very large files, clearly there is some advantage to using a large cluster size, too.

Do understand that FAT space is never truly "lost." When a drive is formatted, the size of the FAT is fixed. And space devoted to the FAT can't be used for file storage, even if it is empty. But when gauging file-storage efficiency, one must take into account the amount of disk space required to record a file's location on the disk as well as the disk space devoted to the file's data. This is especially important when comparing the storage efficiency of the FAT file system with the storage efficiency of others, because many file systems—including NTFS and OS/2's HPFS—do not set aside a fixed amount of room to record file allocations.

All of this begs a bigger question: Given the mix of large and small files on a typical hard disk, what is the optimum cluster size? When you partition a hard disk, how do you determine ahead of time how to size the logical drives to get the maximum storage efficiency? I became interested in this subject while research-

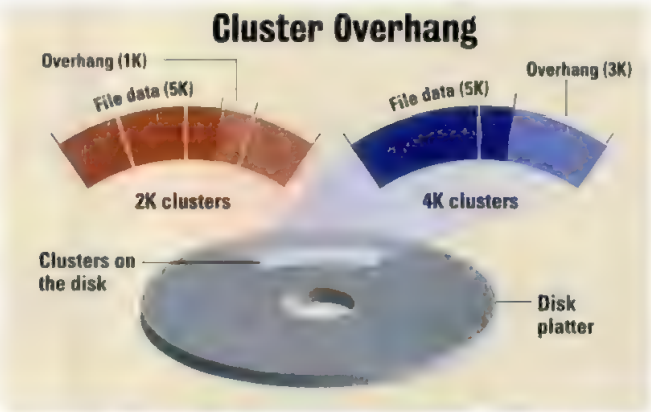

Figure 1: **The FAT and VFAT file systems allocate disk space in clusters. The fact that no file or part of any file may consume less than a full cluster leads to an effect known as *cluster overhang*, which is the unused space between the end of a file's data and the end of the last cluster in which that data is stored. On a drive formatted with 2K clusters, a 5K file requires 6K of storage space and results in 1K of overhang. The same file requires 8K of space on a drive with 4K clusters, resulting in a 3K overhang. In the absence of other mitigating factors, a smaller cluster size produces a higher storage efficiency—fewer wasted bytes per byte of file data.**

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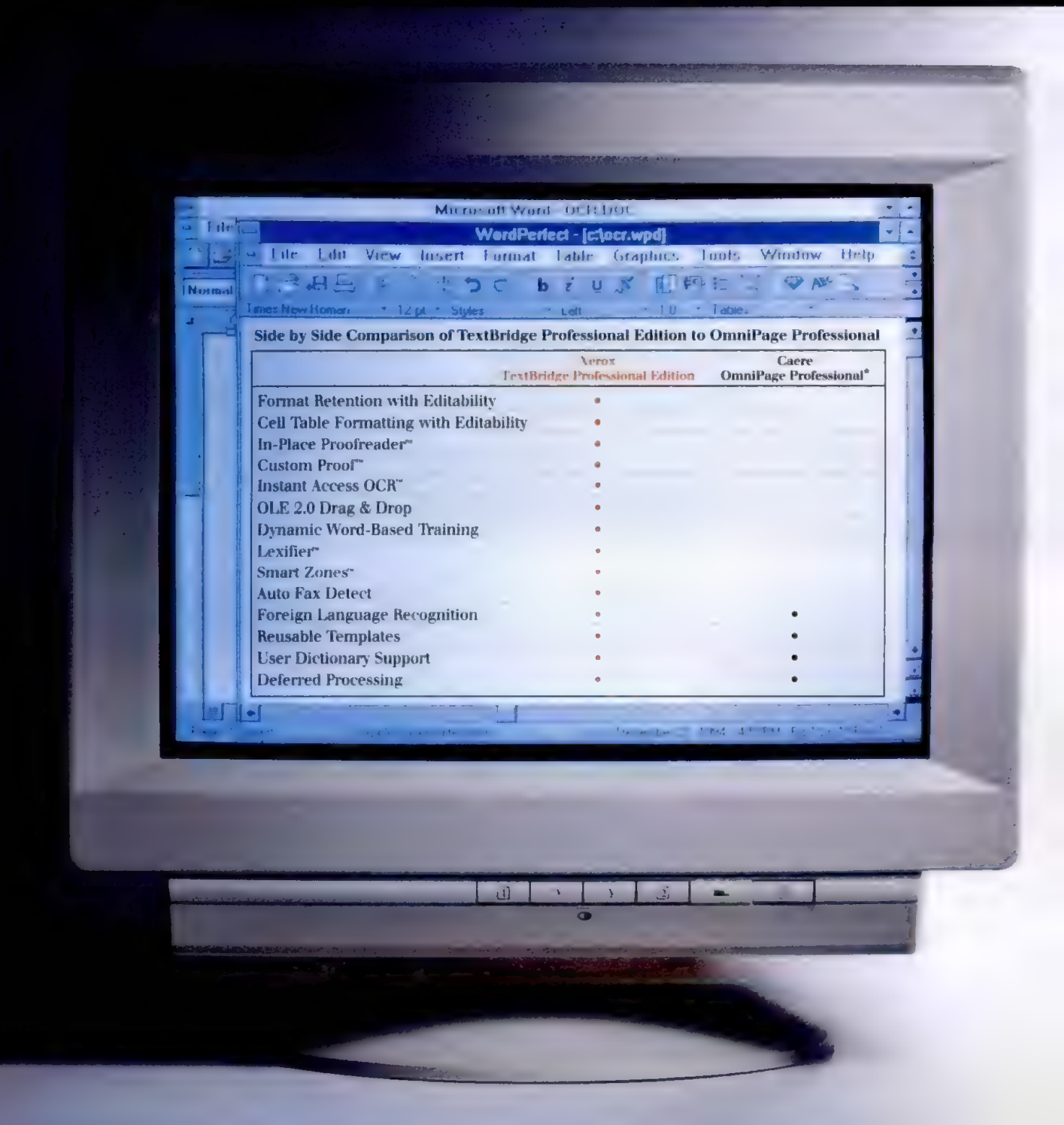

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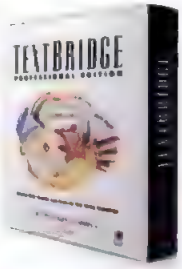

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CIRCLE 078 ON READER SERVICE CARD

Volume Size	Cluster Size
16MB–128MB	2K
128MB–256MB	4K
256MB–512MB	8K
512MB–1GB	16K
1GB–2GB	32K
2GB–4GB	64K

Figure 2: **This table shows volume size versus cluster size for the FAT and VFAT file systems.**

ing last issue's Tutor column, which compared Microsoft Windows 95's VFAT file system with Windows NT's NTFS file system. NTFS restricts the cluster size to 4K, no matter how big the drive. VFAT, on the other hand, uses the same disk-allocation scheme as the FAT file system, so the size of the partition determines the cluster size. Rather than settle for generalities, I decided to find out once and for all what the relationship between cluster size and storage efficiency on a "typical" hard disk is. The answer was not quite what I expected.

GAUGING STORAGE EFFICIENCY The first step in gauging the effect of cluster size on a drive's storage efficiency is defining what "storage efficiency" means. While there is definitely some room for debate on how to quantify storage efficiency, I settled on this simple formula:

$$Eff = \left[\frac{Size}{Size + Overhang + Fatspace}\right] \times 100$$

Eff is the storage efficiency, expressed as a percentage from 0 to 100. *Size* is the combined size of all the files on the drive. *Overhang* is the combined overhang. Adding *Size* and *Overhang* gives you the amount of cluster space that all the files on the drive consume. Finally, *Fatspace* is the amount of space required to map these files in the FAT. Adding this quantity to the sum of *Size* and *Overhang* yields the actual amount of disk space that the files use. This formula calculates the ratio of the files' reported sizes to the physical disk space that they consume, not counting directory entries, which are 32 bytes each, regardless of cluster size. The higher the ratio, the more efficiently disk space is being used.

The second thing that I needed was a tool to collect statistics for every file on a disk and run them through this formula. It could take days to do it by hand, so I wrote the short C program called CHKDRIVE that appears in Figure 3. CHKDRIVE starts in the drive's root directory and uses *recursion* (a technique in which a function or subroutine calls itself) to traverse its way through all the subdirectories.

At each stop, CHKDRIVE uses DOS's FINDFIRST and FINDNEXT functions to enumerate the files in the directory. It keeps a running total of the file sizes, the overhang, and the number of bytes of FAT space required. Since overhang and FAT space are dependent on the cluster size, CHKDRIVE calculates these values for cluster sizes of 2K, 4K,

```
#include <stdio.h>
#include <direct.h>
#include <ctype.h>
#include <dos.h>

void ScanDirectory (char *);
void ProcessFile (struct _find_t *);

unsigned long bytecount = 0;
unsigned long filecount = 0;
unsigned long dircount = 0;

unsigned long overhang[6] = { 0, 0, 0, 0, 0, 0 };
unsigned long fatspace[6] = { 0, 0, 0, 0, 0, 0 };

int main (int argc, char *argv[])
{
    int drive, i;
    char directory[80];
    float efficiency;

    // Save the current drive and directory
    drive = _getdrive ();
    _getcwd (directory, sizeof (directory));

    // Change drives if a drive letter was entered on the command line
    if (argc > 1) {
        if (_chdrive (toupper ((int) argv[1][0]) - 0x40) == -1) {
            printf ("Invalid drive specification\n");
            return;
        }
    }

    // Collect statistics for the drive
    ScanDirectory ("\\");

    // Display the results
    printf ("Scanned %lu files in %lu directories on drive %c:\n",
        filecount, dircount, _getdrive () + 0x40);
    printf ("Cumulative length of all files is %lu bytes\n\n",
            bytecount);

    printf ("Cluster Size    Overhang (Bytes)    FAT Space (Bytes)"\
        "    Efficiency\n");
    printf ("============    ================    =================="\
        "    ==========\n");

    for (i=0; i<6; i++) {
        efficiency = ((float) (bytecount) / (float) (bytecount +
            overhang[i] + fatspace[i])) * 100.0;
        printf ("    %2.0dK        %13.0lu    %17.0lu        %6.1f%%\n",
                2 << i, overhang[i], fatspace[i], efficiency);
    }

    // Restore the drive and directory, and then exit
    _chdrive (drive);
    _chdir (directory);
    return 0;
}

void ScanDirectory (char *directory)
{
    struct _find_t fileinfo;

    dircount++;
    _chdir (directory);

    if (_dos_findfirst ("*.*", _A_HIDDEN | _A_SYSTEM | _A_RDONLY,
        &fileinfo) == 0) {
        ProcessFile (&fileinfo);
        while (_dos_findnext (&fileinfo) == 0)
            ProcessFile (&fileinfo);
    }

    if (_dos_findfirst ("*.*", _A_SUBDIR, &fileinfo) == 0) {
        if ((fileinfo.attrib & _A_SUBDIR) && (fileinfo.name[0] !=
                                                    0x2E))
            ScanDirectory (fileinfo.name);

        while (_dos_findnext (&fileinfo) == 0) {
            if ((fileinfo.attrib & _A_SUBDIR) && (fileinfo.name[0] !=
                                                    0x2E))
                ScanDirectory (fileinfo.name);
        }
    }
    _chdir ("..");
}

void ProcessFile (struct _find_t *fileinfo)
{
    int i;

    filecount++;
    bytecount += fileinfo->size;

    for (i=0; i<6; i++) {
        overhang[i] += (fileinfo->size % ((unsigned long) 2048 << i));
        fatspace[i] += (((fileinfo->size >> (11 + i)) + 1) << i);
    }
}
```

Figure 3: **This C program analyzes all the files on a logical drive and computes the storage efficiency based on the file sizes, the cumulative cluster overhang, and the amount of FAT space required by the files.**

8K, 16K, 32K, and 64K and maintains the running totals for each cluster size independently. Note that the FAT space reported for each cluster is the amount of FAT space that would be required if the files were stored on a drive with the specified cluster size. For this reason, the reported size may exceed the maximum size of the FAT, which is 128K.

After every file on the drive has been analyzed in this manner, CHKDRIVE reports the number of files and directories that it examined, the cumulative file size, and the total overhang, FAT space required by files, and resulting storage efficiency for each of the cluster sizes. In a matter of seconds, CHKDRIVE will analyze a drive containing thousands of files and report the storage efficiencies that you would get if those same files were stored on a drive with a 2K, 4K, 8K, 16K, 32K, or 64K cluster size.

Figure 4 shows the results of running CHKDRIVE on two different hard disks. One of the hard disks was in a desktop PC running Windows 95, and the other was in a laptop running MS-DOS 6.20 and Windows 3.1. Both contained more than 5,000 files in a wide range of sizes.

The results were interesting, to say the least. I had expected to see only a small spread in storage efficiencies, thinking that the presence of several very large files on each disk (some in excess of 2MB) would help offset the inherent inefficiency of a large cluster size. I was wrong. As you can see, the storage efficiency drops off rather quickly as the cluster size increases.

On the second of the two drives (the one for which CHKDRIVE reports having found 6,717 files), which is formatted with 8K clusters, I found that almost 19MB of disk space was lost to cluster overhang. Had the drive been only slightly larger—its current capacity is 500MB, just under the threshold between 8K and 16K clusters—almost 33MB would be lost. Assuming these hard disks are typical of the hard disks used in homes and businesses around the world, the results clearly show that when it comes to cluster size, smaller is better.

This was hardly a scientific study, but I seriously doubt that there are many hard disks out there with so many large files and so few small ones that a larger cluster size would yield a higher storage efficiency. No wonder modern file systems such as NTFS and HPFS limit the cluster size.

The FAT file system was fine in the days of 360K floppies and 10MB hard disks, but today it is grossly antiquated.

The FAT file system was fine in the days of 360K floppies and 10MB hard disks, but today it is grossly antiquated.

WHAT IT MEANS So how does knowing this help you when it comes time to partition a hard disk? Here are a couple of important points to take home:

• You can't pick the cluster size directly, but you can pick it indirectly by choosing the sizes of the partitions and logical drives that you create. Knowing that smaller clusters are likely to yield a higher storage efficiency, limit the sizes of your logical drives to the extent that it is practical to do so.

• Never size a drive so that its capacity equals or slightly exceeds 128MB, 256MB, 512MB, and so on. A 512MB drive won't be used as efficiently as a 511MB drive, because of the increased cluster size.

• As a rule of thumb, it seems smart to keep logical drives below 512MB in the absence of compelling reasons to do otherwise. That should keep storage efficiency in the 90-percent range. Staying below 256MB is even better, but sometimes that's not practical given that some applications today require more than 100MB of disk space.

If you'd like, you can download CHKDRIVE from the Utilities/Tips Forum library on CompuServe's ZiffNet service (GO ZNT:TIPS) and see what it says about your drives. Look for CHKDRV.ZIP in Lib 3 (Tutor); within 30 days of the publication of this issue of *PC Magazine,* you can find it in FREEUTIL (GO ZNT:FREEUTIL). You can also get it through the Internet from our FTP site, *ftp.pcmag.ziff.com,* in this issue's archive file, V14N12.ZIP.

The program's syntax is simple. Typing `CHKDRIVE` analyzes the current drive, while `CHKDRIVE D:` analyzes drive D:. The drive's cluster size does not affect the outcome, because CHKDRIVE performs all its analyses using assumed cluster sizes. If you're curious to know the cluster sizes used on the logical drives in your system, you can find out with DOS's CHKDSK command. If CHKDSK reports "8,192 bytes in each allocation unit," then the cluster size is 8K.

Who knows? Maybe you have one of those rare drives that would benefit from a large cluster size. If you do, drop me a note on PC MagNet with the output from CHKDRIVE. I'd like to see what it says. □

```
Scanned 5172 files in 393 directories on drive C:
Cumulative length of all files is 212562329 bytes

Cluster Size    Overhang (Bytes)    FAT Space (Bytes)    Efficiency
============    ================    =================    ==========
     2K              4710809              213324            97.7%
     4K              8364441              110050            96.2%
     8K             14553497               58686            93.6%
    16K             24572313               33292            89.6%
    32K             38171033               20988            84.8%
    64K             55275929               15144            79.4%

Scanned 6717 files in 372 directories on drive C:
Cumulative length of all files is 279469120 bytes

Cluster Size    Overhang (Bytes)    FAT Space (Bytes)    Efficiency
============    ================    =================    ==========
     2K              5919808              280572            97.8%
     4K             10595392              144720            96.3%
     8K             19086400               77004            93.6%
    16K             33070144               43512            89.4%
    32K             51698752               27336            84.4%
    64K             75062336               19672            78.8%
```

Figure 4: **These drive statistics were obtained by running CHKDRIVE on two different hard disks. Note the decrease in storage efficiency associated with increasing cluster sizes.**

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0312C

Tech Notes

BY BRIAN PROFFIT

OS/2's High Performance File System

The FAT file system has been in use since the early days of personal computing, and back then its limitations were far less apparent. Today, with the increasing size of hard disks, OS/2 or Windows NT users have good reasons to consider moving to an enhanced file system, as I discussed in our May 16 issue. This time I'll go into some detail about how OS/2's High Performance File System (HPFS) achieves its advantages. (For more information on Windows NT's file system, see the Tutor column in our June 13, 1995, issue.)

THE HIGH PERFORMANCE FILE SYSTEM In 1989 IBM and Microsoft jointly introduced HPFS to help OS/2 overcome one more DOS limitation: the file allocation table (FAT) system. The FAT file system worked well in the days when data was stored on floppy disks. But, as Ray Duncan put it in the September 1989 issue of *Microsoft Systems Journal,* "When applied to fixed disks. . .the FAT began to look more like a bug than a feature."

HPFS was designed to address several shortcomings of FAT. These include the 8.3 limit on filenames; fragmentation of files, causing performance problems; wasted disk space because of large cluster sizes; susceptibility to lost data; and limitations on file and disk size. These, and other miscellaneous design compromises, led to less than optimal disk I/O speed. It's worth noting, however, that no matter what combination of file systems you choose for your fixed disk, both OS/2 and NT (which supports HPFS in addition to its own NT File System) continue to use the FAT system exclusively for floppy disks. FAT works fine there, and it allows you to use floppy disks to transfer files back and forth with DOS systems.

As discussed in the previous column on FAT, the FAT system must use increasingly large groups of sectors, called *clusters,* as partition sizes grow. This results in much wasted space, because an average of half of each cluster goes unused. This is even worse in OS/2, because of the way extended attributes (EAs) are stored. In a FAT partition, a file containing only a single character would take one cluster for the file plus one cluster for the extended attributes.

In 1989 IBM and Microsoft jointly introduced HPFS to help OS/2 overcome one more DOS limitation: the file allocation table system.

Since EAs are nearly always less than 300 bytes, the amount of wasted space varies from around half the cluster size on small partitions to a huge percentage of the cluster size on large partitions. Generously estimated, the average amount of wasted space for storage of the file plus storage of its EAs equals or even exceeds the cluster size. For example, suppose your cluster size is 1,024 bytes. On average, 512 bytes of the file's last cluster is wasted. Further suppose that the average EA size for files is 256 bytes (a conservative number). The wasted space for the EAs is 1,024 minus 256, or 768 bytes per file. So for each file, you are wasting an average of 512 plus 768, or 1,280 bytes—more than a full cluster for each file.

Switching a drive to HPFS can produce megabytes of additional free space. HPFS always allocates space based on physical 512-byte sectors rather than on clusters, regardless of the partition size. And HPFS further reduces waste because it can store up to 300 bytes of EAs in a file's Fnode (a new data structure that I'll discuss below) without requiring an additional sector.

FIXED FILE SYSTEM COMPONENTS The first 16 sectors (numbered 0 to 15) of an HPFS partition make up the BootBlock. This area contains the disk label and the system boot code. Sector 16, known as the *SuperBlock*, is chock-full of information. The SuperBlock includes the partition size, a pointer to the root directory, a count of directory entries, the HPFS version in use when the drive was formatted (which is different from the operating system version), the date the partition was last checked and fixed with CHKDSK, and the date the partition was last defragmented. It also contains pointers to the list of bad blocks on the disk, the table of bad sectors, and the list of available sectors.

Sector 17 is known as the *SpareBlock*. It contains a pointer to the list of sectors available for *hot fixing* errors (more about hot fixes later), a count of the hot fix sectors available, a pointer to a pool of free blocks used for managing directory trees, and language code-page information. HPFS uses the code-page information to permit people using different languages to transfer files even when the filenames contain characters not present in all languages. The SpareBlock also includes what is called the "dirty" flag. This new flag tells the operating system whether you shut down properly at the end of the last session or whether there was a power failure (or frustrated fingers on the computer power switch, which amounts to the

same thing) or some other failure to close files properly. If this flag is detected during boot-up, the operating system runs CHKDSK automatically in an attempt to detect and correct any problems introduced into the file system by the improper shutdown.

BASIC DISK LAYOUT When you format a partition, HPFS divides it into *bands* of 8MB each. Each band—which can be thought of as a virtual "minidisk"—has a separate 2K table that indicates which sectors within the band are available or in use. To maximize the amount of contiguous space for files, the tables are alternately located at the front and the end of the band, as Figure 1 shows. This technique allows files of up to 16MB (minus 4K for the tables) to be stored in a single continuous chunk.

Figure 1: **HPFS keeps the maximum amount of contiguous space available.**

The High Performance File System then estimates the directory size by calculating the number of directory entries expected in a partition of this size and reserves that much space in the band closest to the middle of the disk. In fact, immediately after formatting, an HPFS volume looks as if it holds less than it did under FAT, because five 2K blocks for each megabyte of the logical drive have already been reserved. As you create files, the directories are allocated from this space in the middle of the disk. In this way, HPFS ensures that the physical heads that read your data never need to move farther than half the width of the disk to get to your data.

The fact that the entire space is preallocated also allows HPFS to use specially optimized software for handling directories more quickly and efficiently. Contrast this with the FAT system, which requires the heads to go all the way to the beginning of the drive to reach the FAT, then back across the disk to find a cluster, then back to the front to read the FAT for the location of the next cluster, and so on. And the process gets even worse as the disk becomes fragmented. You can see why putting the directory in the middle of the disk immediately improves performance. Incidentallly, this preallocation doesn't limit the number of files you can have on the hard disk. In the very unlikely event that HPFS needs more space than it originally reserved for the directories, it can allocate more in any available area on the disk.

The number of files in each directory block is variable and depends on the length of the filenames represented there. That's because HPFS has eliminated the restriction of filenames to eight characters and a three-character extension. HPFS filenames can be up to 254 characters long and may include upper- and lowercase characters, blanks, and multiple periods. The filenames are kept sorted, based on the character sequence in the system's current code page. For U.S. English, this matches alphabetical order.

Another speed improvement comes from the way directory entries are stored. The FAT system searches each entry in the directory sequentially to find the desired file. So in the worst-case scenario, the system must trudge through every file in the directory to find the last one. HPFS, however, stores directory entries using a data structure called a B- tree. (See the sidebar "Binary Tree Data Structures.") Each directory entry begins with a number indicating the entry's length, which varies with the length of the filename. It then includes time and date stamps for the file, file size, attribute flags (read-only, archive, hidden, and system), and a pointer to the file's *Fnode*. Each file (and directory) has an Fnode, a one-sector data structure containing critical information about the file.

The Fnode contains a pointer to the start of the file, the first 15 characters of the filename, additional Last Write and Last Access time stamps, file access history, an allocation structure describing the file's layout on the disk, and the first 300 bytes of the file's extended attributes. (There are rarely more than 300 bytes of EAs, which effectively means that one less sector must be read to gather this information under HPFS than under FAT.) IBM's LAN Server and LAN Manager programs also store user Access Control information in the file's Fnode. Note that Fnodes are stored adjacent to the file they represent so that when you open a file, the four sectors that are automatically read into the cache contain the Fnode and the first three sectors of the file.

The HPFS allocation structure gains further efficiency over the file allocation table through a technique called Run Length Encoding (RLE). Rather than indicating each individual sector used in a table, HPFS stores a pointer to the first sector and a count of the number of consecutive sectors used. Each such sector/length combination is called an *extent*. I'll discuss how HPFS minimizes fragmentation shortly, but since some fragmentation can still occur, it's worth noting that such situations are handled by adding extents in the Fnode. One Fnode can store up to eight extents, providing plenty of space for most files. And if still more space is needed, HPFS changes the structure so that the space in the Fnode becomes the root of a B+ tree of allocation sectors. (A B+ tree is a variant of the B- tree described in the sidebar.)

Note that many modern disk controllers are already able to read more than one sector in a single operation, if instructed to do so. The HPFS scheme greatly increases the likelihood that this feature will be exploited, further reducing the number of required interactions between the program, the file system, the disk device driver, and the physical disk.

OTHER HPFS OPTIMIZATIONS When you open or create a file, a smart algorithm assigns the best band for you to use. The program interface used to create a file allows the programmer to tell the operating system how big the file is expected to be. Using that information, HPFS can plan in advance to put the file in a band with that much contiguous space available. (That's why the bigger your partition, the better HPFS can manage it—more bands means more options.)

Suppose your multithreaded operating system is creating four new files simultaneously on a FAT drive. As each file needs a new sector, it grabs the next avail-

able spot in the file allocation table. This results in considerable fragmentation, since the clusters are assigned in an interleaved fashion. HPFS would assign a different band to each of the four so that its contents could remain contiguous.

I mentioned above that when a program opens a file, the Fnode and the first three sectors are read and cached for use by that program. If the file being opened is an executable or if the file-access history information in the Fnode indicates that the file is often read in its entirety after opening, many more sectors will automatically be preread and cached.

Write operations are cached in a special way, referred to as *lazy write*. When a program sends a write instruction, HPFS takes the data into its cache and immediately tells the program that the data has already been written. This eliminates the long delay of actual disk I/O and lets the program get back to its business right away. HPFS can then take advantage of the multitasking abilities of OS/2 and NT to actually write the data in a separate thread in the background.

TOO LAZY? The use of lazy writes adds a lot of speed to your system, but it also introduces a risk to the integrity of your data. Suppose that when HPFS gets around to trying to write the data, the device driver reports a disk error. Your program is already off doing other things, since HPFS told it that the data was successfully written. This possibility is the reason for the list of *hot fix* blocks I mentioned above in connection with the SpareBlock.

If a disk write fails, HPFS looks in the SpareBlock for an available hot fix block. The data is written in the hot fix location, and the bad block tables in the SuperBlock are updated to indicate which sector is bad and which block has been used to store the data. Future read requests for the bad sector will automatically be rerouted by HPFS to the new location. When CHKDSK is next run, the file will be copied to a new location where it can be stored contiguously, without the jump to the hot fix block and back. The hot fix block will then be freed for use if there's another such problem. The user won't know or care, since the problem is resolved automatically.

The code for HPFS also provides multiple-level caches for greater efficiency. For example, in addition to caching your data, it caches subdirectories. It will also "cache" a complete path by keeping a checksum in memory that uniquely identifies the path. So if you access a file way down the directory chain, then the next time you open the file you'll likely go straight to that subdirectory without traversing the tree.

FAULT TOLERANCE On a FAT drive, you're pretty much out of luck if the file allocation table is erased. The directory only contains the filename, size, and starting cluster. Only if the file is contiguous can you recover it. Worse, since pointers to subdirectories are contained in the FAT, you're likely to lose everything that's not in the root directory.

With HPFS, the counterpart to the file allocation table is the bitmap area, which contains a flag indicating sectors in use. If that bitmap area gets destroyed, you won't even know it—even if the system was running at the time. The file's Fnode also stores the allocation information for each file. So the bitmap area can be recovered by a search through the Fnodes. The user won't even see a warning—the search happens automatically. You can activate this process by running CHKDSK, which compares the bitmap with the files' information about the sectors they own. If there is an error reading the bitmap, a new one is created.

Suppose your directories are overwritten. With FAT, you lose the pointers to the start of each file's chain of clusters. You can try to put them together into files, but you have to do a lot manually. Because utilities such as CHKDISK don't

Binary Tree Data Structures

Designed as a method for locating a specific piece of data more quickly than a sequential search, a binary tree really does resemble a tree made up of two-choice branches. A short tree of telephone area codes might look like Figure A. If you're searching for area code 513, for example, you start at the top of the tree, and because 513 is greater than 212, you take the right branch. Again, 513 is greater than 407, so you again take the right branch and find the desired entry. With this method, you find the information with only two comparisons; a sequential search would require five.

The efficiency of binary trees depends, however, on the sequence in which new items are added. If you now add area code 617, it goes after 513. And if you then add 714, it goes after 617. So if entries are added in sorted order, the resulting tree becomes more and more like a sequential structure, as Figure B shows.

The B- tree structure was designed to help prevent this problem. This technique includes intelligence to keep the tree balanced. The structure of Figure B would be rearranged to look like Figure C. This makes the tree more efficient, but adds more overhead as the tree is balanced each time an entry is added or removed, or when an area code is changed.—*Brian Proffit*

Figure A: **This is a short binary tree of telephone area codes. Starting at 212, the search goes left for lower numbers and right for higher numbers.**

Figure B: **As new area codes are added, the tree begins to look like a sequentially structured file.**

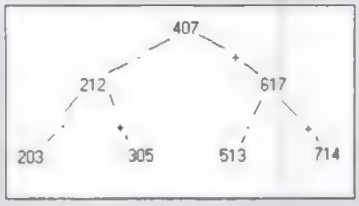

Figure C: **Rearranging the structure to use a B- tree increases the search efficiency.**

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know the filename (and leave you with a series of files that have names like FILE*xxxx*.CHK), you have to try to load files into an editor and figure out what they are in order to restore their old names. This is a real challenge: Because most files are binary, all you see in the editor is a long string of gibberish.

With HPFS, if you lose the directory, you lose the last write date and modification date, the creation date, and the long filename (after the first 15 characters), but that's all. The directory entry is nothing more than a pointer to the Fnode. The Fnode stores the first 15 characters of the filename (and an indication if there were more characters) and all other access information. Recovery utilities can then search the Fnodes to find the one for your file. This redundancy between the directory and the Fnode greatly increases your chances of recovering data. CHKDSK is currently the only recovery utility that ships with OS/2, and unfortunately it doesn't yet use all this information. For example, CHKDSK knows the name of the file from the Fnode, but still names it FILE*xxxx*.CHK. But although IBM isn't fixing its own programs, it is working with vendors such as SofTouch Systems and WarpSpeed Computers so that products like the GammaTech Utilities and the Graham Utilities can do a much better job than CHKDSK.

CAPACITIES The High Performance File System itself doesn't impose a maximum file size, but OS/2 currently sets a limit of 2GB per file. For partitions, the design goal of HPFS is 2 terabytes (that's trillions, like the U.S. national debt), but the current limit is 64GB because parts of HPFS are still 16-bit. A FAT partition can only hold 65,518 files, while an HPFS volume can hold 2×10^{13}.

When you put this all together, it seems clear that your ground beef is not the only thing that could stand to lose some FAT. □

BRIAN PROFFIT WAS DIRECTOR OF *PC WEEK'S* CORPORATE LABS BEFORE LEAVING TO BECOME PRESIDENT OF VISIONARY RESEARCH, AN INDUSTRY CONSULTING FIRM. HE IS SENIOR CONTRIBUTING EDITOR TO *OS/2 MAGAZINE*, CONTRIBUTING EDITOR TO *INTERACTIVITY*, AND A FREQUENT CONTRIBUTOR TO *PC MAGAZINE*.

Extending Your Apps

BY ERICA KERWIEN

Enhancing Your Notes Mail

E-mail is rapidly taking the place of other forms of communication in the workplace, particularly when the setting is a workgroup sharing information over a network. Lotus Notes has become increasingly popular in such settings because of the power it offers, but it has never been known for ease of use. Release 4, expected in mid-1995, promises an easier and richer environment for customizing Notes mail, but realistically it will be some time before Release 3.x disappears from the desktop. In the meantime, there's a lot you can do to customize your mail file.

The enhancements we'll discuss in this column range from the basic—editing a reply form to inherit the previous memo's content—to the more advanced—creating a macro to carry out an action on documents in your mail file. I'll detail the techniques and show you, with examples, how to implement the enhancements.

All Notes users have Manager access to their mail files—Designer or Manager access is required to make design changes to any Notes database, including your Mail file, which is also a Notes database. You can implement design changes to the forms in your mail file simply by highlighting your Mail file on the Notes desktop and choosing Forms... from the Design menu. Similarly, you change other parts of the database such as the macros or views by choosing Design | Macros or Design | Views.

CREATING A NEW REPLY FORM When you reply to a memo, normally you're presented with a blank form on which to type your reply. But have you ever wanted to include the contents of the previous memo in your reply? It's easy. Let's create a new form based on the default reply form that will inherit the desired fields, usually the From, Date, and Body field contents, from the original memo.

The standard Notes mail file is based on a Notes template file called Mail.NTF that comes with Notes. When you make changes to your mail file, be sure to save a copy of the database, without documents, as a template in case you need to restore it at a later date. To make the template, select your mail file on the Notes desktop, choose File | Database | Copy, and in the Database Copy dialog select the Design Only and Access Control List options (do not copy documents). You can choose any filename, just make sure to give it a .NTF extension so that Notes recognizes this as a template file. The database title does not have any relevance other than your own preference for database titles.

There's a lot you can do to customize your Notes mail—from changing your reply form to writing an auto-reply macro.

To begin designing the reply form, highlight your Notes mail file and choose Design | Forms from the menu bar. All the forms in your mail file will appear in this Design Forms dialog box, as shown in Figure 1. We could start with a blank form, but it's easier to use one of the existing forms, such as the Reply or Reply To All forms, because they already contain a number of the fields we want. The difference between the Reply and Reply To All forms is that Reply To All sends a reply to all the recipients of the original memo listed in the To (SendTo) or cc (CopyTo) fields of the original memo, while the Reply form sends a reply only to the recipient in the To (SendTo) field of the original.

Let's use the Reply form. Highlight it and press the New Copy button, and a copy of the Reply form appears. We will add three fields to the new form, From, DisplayDate, and Body, which will contain content from the original memo. Before we lay out these fields, though, we'll place some static text below the Body field to separate the new fields visually from the original memo fields. This will let readers easily distinguish between the new memo and the original. Place the cursor directly after the Body field and press the Enter key twice to insert two lines between the field and the static text. Now type "—— Previous Memo ——" (or any text you prefer) to create a header for the original memo. You can change the color of the text by highlighting all or part of it and choosing Text | Font. The Font dialog box has a Color bar along the bottom offering a choice of several colors. Select a color and then click OK to close the dialog box and see the resulting color change.

The new fields will follow the static text, and we'll label two of them, the From and DisplayDate fields. We could create a label for the Body field as well, but in this example we'll simply let the Body contents fall flush left below the Date label. To create the labels, put the cursor after the static text and press the Enter key twice to add two lines. Type "From:" and then add two spaces to separate the label from the field contents. Press Enter twice again to insert two more lines and then type the "Date:" label. Add two spaces after the Date field label. As with the static text, you can adjust the style of the label by selecting options in the Font dialog.

Now we'll create the new fields. We could use the Design | New Field menu option, but we don't need to. Instead we'll copy existing fields on this new form and paste them below the static text. By doing this, the fields automatically have a "_1" added to the end of

their names to distinguish them from the original fields. Highlight the From field at the top of this form and choose Edit | Copy (or press Ctrl-C) to copy the field to the Notes clipboard. Now place the cursor after your From: field label and choose Edit | Paste (or press Ctrl-V) to paste the field onto the form.

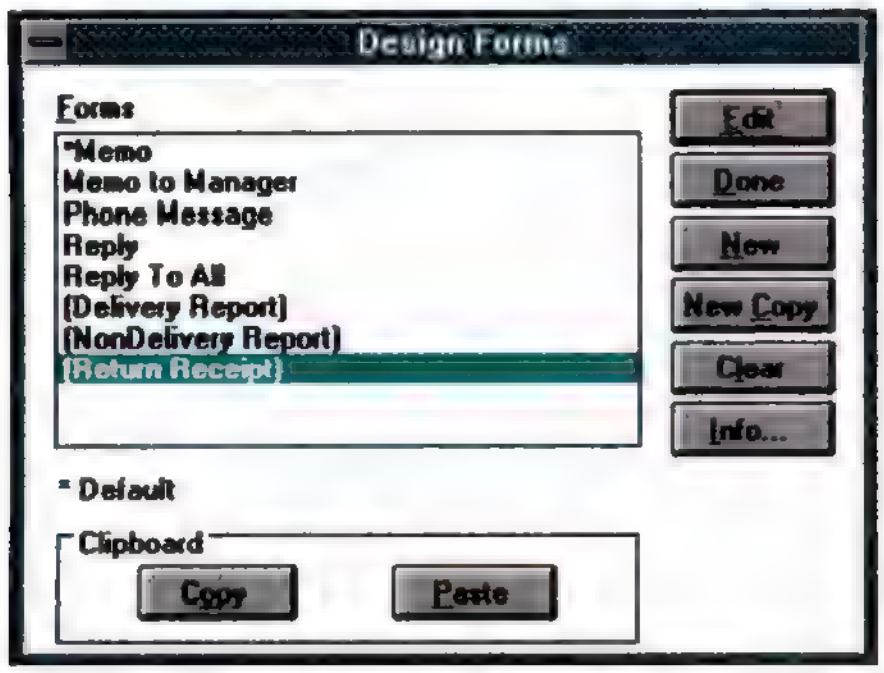


***Figure 1:* This is the Design Forms dialog box that shows all the forms in your mail file.**

Next, copy the DisplayDate field from the top of the form and paste it next to the Date label. Do the same for the Body field, pasting it two lines below the Date. The form should look like the one in Figure 2.

Let's take a closer look at the form's attributes and field formulas for the fields that we just added. Choose Design | Form Attributes to bring up the dialog box shown in Figure 3. Enter the name of the form at the top of the dialog box; we'll call ours "Reply w/previous memo." You'll want to do this early on so that you can save the form as often as you like while making design changes. (Save the form when the form window is the topmost window by choosing File | Save.)

***Figure 2:* This is the "Reply w/previous memo" form, showing the new fields.**

In the Design Form Attributes dialog, make sure the option "Inherit default field values" is checked. This tells the form to grab data from the highlighted document, the document to which you're replying. Check that "Store form in documents" is marked as well. Because the reply memo form you're creating resides only in your mail file, recipients of the memo will be unable to read it unless the form is stored with the document. Normally, Notes uses the forms available in the current Notes database to display the data in a document. If your reply document uses a form in your mail database but doesn't have the form stored with it when it's mailed, the recipient receives a message saying Notes cannot locate the form; Notes then uses the default form in the recipient's mail database to display the reply as best it can. (You can tell which is the default form in a database—there's only one—by choosing Design | Forms. The form with the asterisk next to it is the default.) The drawback to using the "Store form in documents" feature is that it increases the document's size, thus increasing the size of the recipient's mail database.

The next step is to set the desired field attributes and enter the field formulas, which is done in the Field Definition dialog box. The easiest way to access the dialog is by double-clicking a field, though you can also highlight the field and choose Design | Field Definition or simply move to the field with the arrow keys and then press the Spacebar or Enter. So, to set the attributes for the From_1 field, double-click on that field. The Data Type should be set to Names and the Field Type to "Computed when composed." To add the formula to the From_1 field, select the Formula button at the bottom of the dialog box (or press Alt-L) and type "SendTo" (without the quotation marks), which is the field being populated at the top of the form when the form is composed.

Follow this procedure to set the field attributes and formulas for the other fields. Design the DisplayDate_1 field with the following settings:

```
Data Type = Time
Field Type = Computed when composed
Formula = DeliveredDate
```

The Body_1 field should have these settings:

```
Data Type = Rich Text
Field Type = Non-editable
Formula = Body
```

Note that the formula for DisplayDate_1 is DeliveredDate. This is a hidden field that Notes adds when it delivers each mail document to the mail database. To view the contents of this field and other hidden fields in a document, select the document (or open it) and choose Design | Document Info. The formula for the field Body_1 is Body, as shown in Figure 4.

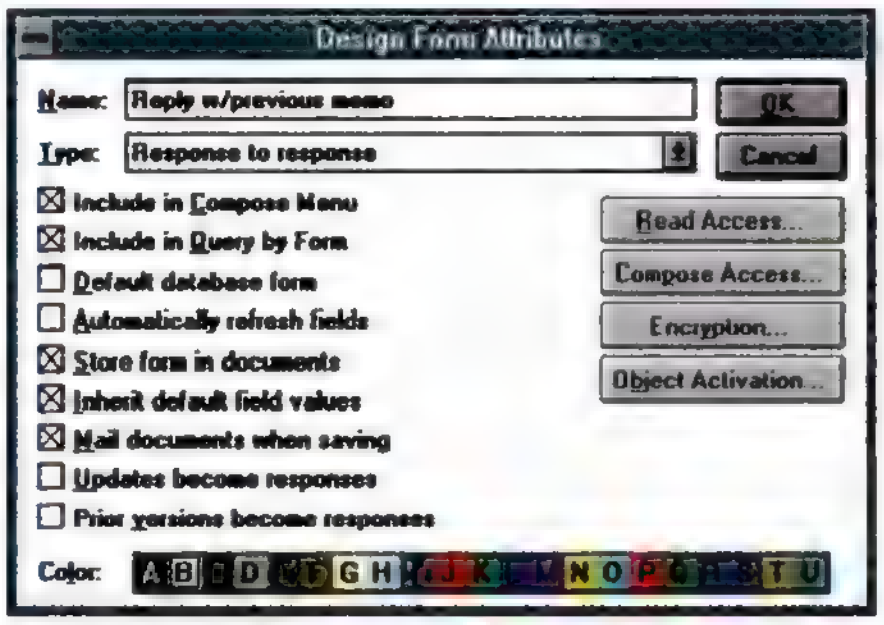


***Figure 3:* This is the Design Form Attributes dialog box.**

To conclude your design work, save and close the form. The new reply form will now appear in your Compose menu (the form name appears in the Compose menu after you save it at least once). To test your new reply form, select a document to reply to and choose the form "Reply w/previous memo" from the Compose menu. The new reply opens in a new window, and Notes populates the usual fields as well as the fields we added (From_1, DisplayDate_1, and Body_1) in the second half of the reply.

There's a lot more you can do to customize your mail forms, such as adding a company logo and a digitized signature, or doing a complete aesthetic make-over of your mail forms. If you're an administrator or designer thinking about rolling out a customized mail form for your entire organization, create a Notes mail template (Mail.NTF) and redesign everyone's mail file based on this customized template. As a Notes administrator or designer, you can also add this customized Mail.NTF file to the install files so that each new install is automatically created with the custom mail forms.

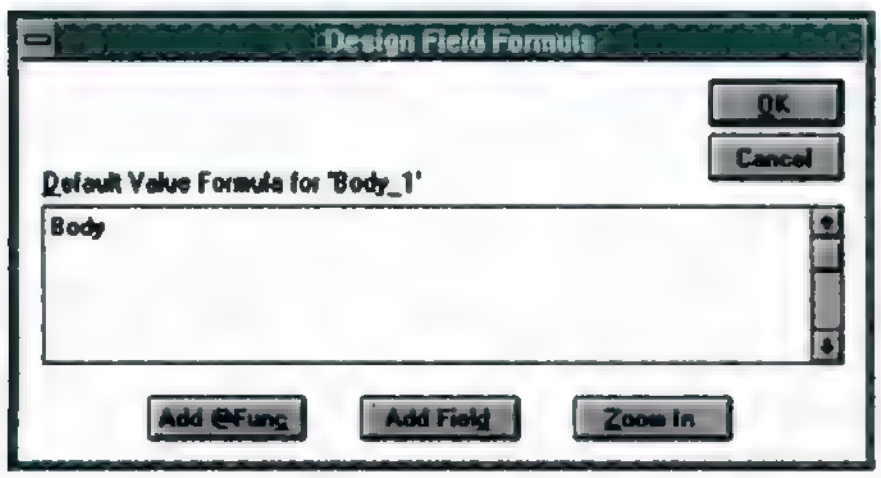


Figure 4: **You add formulas to fields using this dialog box.**

You can also add the custom mail form to the Forms.NTF template. A copy of the template must be placed on every mail server, and then all users can access the forms in Forms.NTF by choosing Mail | Compose | Custom Forms. With this technique you must still store the form with the document if the form exists only in the Forms.NTF template.

CREATING AN AUTO-REPLY MACRO

Now let's look at a more advanced topic. Have you ever wanted to send an automatic reply to mail received while you're away? Here's a macro that will do the trick on such occasions.

Remember, though, that when creating and running macros on working documents, it's always a good idea to test the macro before implementing it on live data. Normally, I'd suggest you create a copy of your working database as a test database, copy and paste a few documents into the test database, and then run the macro on the test database. In this case, however, you don't want to have more than one copy of your mail file on a server, because this will confuse the mail router and make a mess of your mail. Instead, you can test the macro by running it on an off-line client (one not connected to a Notes server) and the auto-reply mail will be sent to your Outgoing mailbox, where you can just delete it.

A test I like to use when connected to a Notes server is to send the test replies to myself, so they go through the mail router and back into my mail database. To do this, create a document with the required criteria for an automatic reply, and then mail it to yourself. Of course, there is always the thoughtful "I'm just testing, please delete this note when you get it" message to your fellow Notes users. In all testing cases, run the macro from the menu before you make it a background macro so that you can control when the macro performs actions.

The macro that we are creating here is a background macro that will run at the frequency we set. The macro scans the documents in the mail file, and when it finds documents that fit the criteria in the macro formula, it creates a document with a tailored reply and mails the reply to the recipients.

The first step is to highlight the mail file and choose Design | Macros, which brings up the Design Macros dialog box. Click on the New button to bring up the Design New Macro dialog box, shown in Figure 5, which is used to assign the characteristics of the macro.

Give your macro a name, then select the Run option "Run periodically in the background." Next choose the Operation "Create new documents when run." You don't have a choice with the "Run macro on:" option—background macros run only on documents not yet processed by the macro, so Notes grays out the selection. In the text box "Server-/workstation on which to run," enter the name of your mail server.

If you are a remote Notes user and want to run this macro on the local replicating copy of your mail database, add your user name as the server/workstation on which to run the background macro. This will send the replies to your Outgoing mailbox, and they will be mailed the next time you send mail. This isn't ideal for this type of application, though: If you aren't around to replicate the automatic replies back to your remote mail server, they will never reach the intended recipients. To run background macros on local databases, you'll need to choose Tools | Setup | User and check off Background Macros in the Startup Options section of the dialog box.

Finally, the frequency option is up to you, but bear in mind you'll be taking up your mail server's resources (and thus will have a very unhappy Notes administrator) if you set your macro to run every hour. Running it once a day is probably sufficient.

Don't forget to insert a comment at the bottom of the Design New Macro dialog box so that when you return to it eons later, you'll remember what this macro does. This may appear redundant, since you can name a macro anything you want. But it's easier in the long run if you add a brief comment for future reference.

Now we're ready to add the macro formula. If you're new to writing formulas, you'll want to take advantage of the Add@Func and Add Field buttons you find in all formula dialog boxes. The Add@Func button brings up a list of @functions available for insertion in the formula. Just place the cursor in the formula where you want to enter the @function, press the Add@Func button, select the @function, and click on the Paste button. Of course you still must know how to apply the syntax for the @function (the on-line and hard-copy Notes documentation can help with this). The Add Field button offers you a list of fields in the database to use in your formula; a field is added in the same way as an @function.

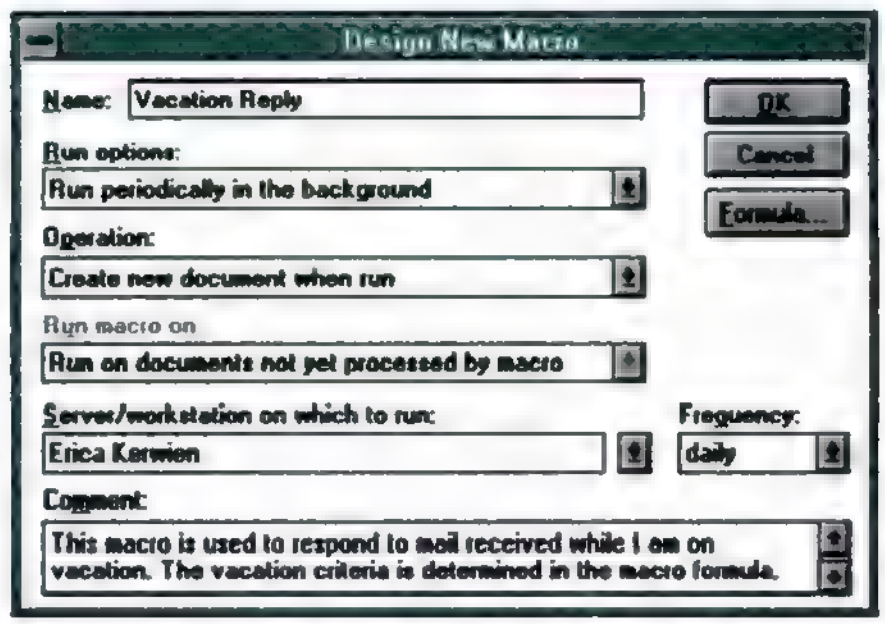


Figure 5: **You use the Design New Macro dialog box to assign the characteristics of the macro.**

```
(a)
@If (From = "Erica Kerwien" | DeliveredDate = ""; @Return (""));
DeliveredDate > @Date(1995;4;2) & DeliveredDate < @Date(1995;4;9);
@MailSend (From; ""; "Erica Kerwien";  Subject; "I will be on vacation
from 4/3/95 to 4/7/95 and will be unable to answer your note at this
time. I will respond on my return, 4/10/95."); @Return (""));
Select @All

(b)
@If (From = "<your name>" | DeliveredDate = ""; @Return (""));
DeliveredDate > @Date(<your date here>) & DeliveredDate < @Date(<your
date here>); @MailSend (From; ""; "<your name>";  Subject; "<your
message here>"); @Return (""));
Select @All

(c)
@If (From = "Erica Kerwien" | DeliveredDate = ""; @Return (""));
DeliveredDate = @Date(1995;4;6) & @Contains(From; "<user or group
name>" ; @MailSend (From; ""; "Erica Kerwien";  Subject; "I am in a
meeting all day today, however please contact Ken Wright with further
questions at x125, or wait until I return tomorrow."); @Return ""));
Select @All
```

Figure 6: **These are formulas for macros that reply automatically to Notes mail, depending on the date and other criteria you set.**

To add the formula for your auto-reply macro, click on the Formula button in the Design New Macro dialog box to bring up the Edit Macro Formula dialog box. This is the dialog box where you add the macro formula shown in Figure 6a.

The formula is a conditional statement that says if the field From in a document equals your name and the field DeliveredDate is empty, then stop this formula right here (@Return)—you don't want to send replies to yourself or to unsent mail. Otherwise, if a document's DeliveredDate field contains a date greater than the one you request (using the @Date function) and less than another date you specify, then mail a document to the original sender with a message in the body field. And finally, if the document does not meet the date criteria specified in the formula, just end the formula (the last @Return). Select@All selects all the documents in the view for the macro to act upon.

If you make a mistake typing this formula in, Notes will alert you to the error. For example, leaving out a semicolon or a right or left parenthesis is not forgiven in Notes, and Notes will let you know. If you type a field name incorrectly, the formula will not work because it cannot find the field you are referring to; thus it's a good idea to use the Add@Func and Add Field buttons as often as possible to avoid annoying typos in your formulas.

For demonstration purposes, I added my name to the macro as if it were in my mail database. Figure 6b shows a more generic version of the formula so you can see where to insert your own information. The variables you need to fill in are surrounded by carets.

In these formulas we used the @Date function, like so:

```
DeliveredDate > @Date(1995;4;2)
& DeliveredDate < @Date(1995;4;9);
```

If you prefer, you can place the actual date in the formula surrounded by brackets, like this:

```
DeliveredDate > [4/2/95]
& DeliveredDate < [4/9/95];
```

Note that you can use the macro again by refreshing the date criteria, and you can adjust the formula for other situations. For example, if you'll be in a meeting during an entire day and want certain people to know why you are not responding to messages immediately, the formula could reflect this (see Figure 6c). Of course, you'd want to run this macro periodically in the background, at an hourly frequency to be effective over the stretch of a day's mail.

A MACRO TO CATEGORIZE MAIL I don't believe a computer will ever be able to figure out the pattern behind my organizational habits. Still, if you'd like Notes to categorize mail documents based on certain criteria, here's a way to do it with a macro you design in your mail database.

Suppose you receive regular notes from a development meeting you attend once a week, and the Subject field always contains the phrase "development meeting." As long as this phrase is consistent, it can be the criterion on which you base the macro. Here's an example of a macro that will sort meeting notes:

```
FIELD Categories := @If
(@Contains (@LowerCase (Subject);
"development meeting"); "Meeting
Notes";
Categories);
SELECT @All
```

Unlike when you manually created categories, the category will be created automatically if it doesn't yet exist in the database (you need at least one document in the category for the category to exist in the database).

You can run the macro periodically in the background on all documents in the view (or database) or you can run it from the menu (Tools | Run Macros). In either case select the Operation "Update existing documents when run."

I've created a sample mail database that contains the forms and macros presented in this article. To get a copy, download the file Examples.NSF from ZiffNet's Programming Forum (GO ZNT: PROGRAM) and place it in a directory where you store other Notes databases. Add the database to your workspace by choosing File | Open Database and navigating to where you've placed Examples.NSF. Look for "Sample Mail DB" (the title of the database); select it and click on the Open button.

To copy the new Reply memo to your mail database, highlight the database and choose Design | Forms. In the Design Forms dialog box, highlight the "Reply w/previous memo" form and press the copy button to copy the form to the Notes clipboard. Click on the Done button to exit the dialog box and highlight your mail database on the Notes workspace. Choose Design | Forms and press the Paste button in the Design Forms dialog. You have now pasted the form into your own mail database, where the form will appear in the Compose menu. The procedure for copying a macro is similar except that you choose Design | Macros instead of Design | Forms. Don't forget to customize the macros for your own use.

As you can see, there's a lot you can do to enhance your electronic mail even before the newest version of Notes arrives. □

ERICA KERWIEN IS THE AUTHOR OF *LOTUS NOTES APPLICATION DEVELOPMENT HANDBOOK*, PUBLISHED BY PROGRAMMERS PRESS.

Utilities

BY NEIL J. RUBENKING

Select and Collect Your Icons

Icons are an important part of the visual appeal of Windows. They personalize the screen and add color and charm. Custom icons are so popular that Windows itself comes with two bundled collections: MORICONS .DLL and the icons contained in PROGMAN.EXE. You can create your own icons with an icon editor or download icons created by others from on-line services such as CompuServe. Programming tools such as Visual Basic and Delphi come with large collections of icon files.

Although there is no shortage of icons, there is a shortage of good ways to manage, view, and select all these icons. Also, collections of icons in separate files can take up large amounts of disk space because of the large cluster size on big hard disks. IconJack, this issue's utility, eases the process of collecting and managing icons in several different ways. It lets you:

- select .ICO files visually, instead of guessing at filenames;
- view icons embedded in .EXE and .DLL files;
- extract an embedded icon to a separate .ICO file;
- store a collection of icons as a Windows .DLL file.

You can download IconJack and its source code from the Internet or from the ZiffNet service of CompuServe or you can obtain the files by mail. Refer to the sidebar "Guide to Our Utilities & How To Get Them" for details.

USING ICONJACK To install IconJack, simply place the two program files, ICONJACK.EXE and ICONJACK.HLP, in a subdirectory on your hard disk. That's it! No other files are required. Add a program item for IconJack to the Program Manager group of your choice, and the installation is complete. To de-install IconJack, delete ICONJACK.EXE, ICONJACK.HLP, and ICONJACK.INI.

It's awfully difficult to select an icon based on its filename. What does MISC-44.ICO represent, or TRFFC10A .ICO? How does ARW03DN.ICO differ from ARW02DN.ICO? You really can't tell without a look at your icon collection. Launch IconJack and select Read Icons... from its File menu. An Open File common dialog box will appear. Pull down the List Files of Type combo box in the lower-left corner and select Icon files. Now navigate to a directory that contains some .ICO files. To select all the files listed, click on the first and Shift-<Click> on the last. Press OK and IconJack will display the files you selected (see Figure 1). To add more files, perhaps from another directory, choose Read Files... again. (Note that if you load the same file twice, IconJack will treat it as two files.)

Notice the tiny capital I next to the top-left corner of each icon. This indicates that the icon came from an .ICO file, as opposed to being extracted from an .EXE or .DLL. You can now scan the collection of icons until you find one you like. Click on an icon to display its filename on the status bar.

Another way to select icons for display is to drag them from File Manager. Bring up File Manager and select Search from the File menu. Search for files matching *.ICO starting from the root directory and check the box captioned Search All Subdirectories. When File Manager finishes searching, highlight the entire list of found files and drag it onto the IconJack window. Now you're viewing every .ICO file on the disk!

Not all icons exist as independent .ICO files. For example, PROGMAN.EXE (the executable file for Program Manager) contains 46 icons that you can use to represent program items. If that's not enough, the MORICONS.DLL file that comes with Windows holds over a hundred additional icons. And every normal Windows .EXE file has one or more icons embedded in it. IconJack will load these icons too! Just select .EXE or .DLL files to extract all of their icons for your viewing pleasure. Or, if you prefer, drag .EXE or .DLL files onto IconJack from File Manager. When you highlight an icon that came from an .EXE or .DLL file, IconJack's status bar displays both the name of the source file and the icon's index number within that file. If a particular .EXE or .DLL file isn't a valid Windows file or doesn't contain any icons, IconJack will just skip it.

IconJack can extract icons from .EXE and .DLL files written for 16-bit Windows (Windows 3.1 or Windows for Workgroups). The format of these files is called New Executable (NE), to distinguish it from the older DOS-only executable file format. Windows 95 and Windows NT use a still newer format for executable files called the Portable Executable (PE) format. IconJack can display icons from PE files, but it can extract only one image of the icon. And if the icon has only a 2-color image, IconJack can't extract it at all. Since icons extracted from PE files can

Top 10 Utilities

Rank	Filename
1	**FDDLLS**—*Finds and removes dead DLLs*
2	**INCTRL**—*Oversees program installation*
3	**FINDIR**—*Analyzes IRQ line usage*
4	**WTIM**—*Keeps PC clock time accurate*
5	**WINCMD**—*A Windows batch language*
6	**MYGRPS**—*Customizes group icons*
7	**SLICE**—*Slices large files for copying*
8	**BUGS**—*A Windows 3.1 screen saver*
9	**SCHED**—*Schedules program execution*
10	**PLICON**—*Places icons where you want*

This list is based on the total number of downloads each utility has had on PC MagNet over the past month. To download these files, type GO ZNT:TIPS. For more information, see the sidebar "Guide to Our Utilities & How to Get Them."

Figure 1: **Here IconJack is displaying some of the .ICO files that come with Delphi.**

be troublesome, IconJack flags them by putting a small capital P near their top left corner and by adding "(PE)" after the filename on the status bar.

SAVING EXTRACTED ICONS Perhaps you'd like to use one of the MORICONS.DLL icons as a starting point for designing an icon of your own. Just highlight the icon in IconJack's display and choose Save Icon as .ICO from the File menu. (If no icon is highlighted, or if the highlighted icon is already in .ICO file form, this menu choice will be disabled.) The resulting .ICO file will be complete, including all the images of the original. For example, most of the MORICONS .DLL icons contain a 16-color image and a 2-color image; IconJack will get both.

In order to extract all images of the icon, IconJack has to read the source .EXE or .DLL again. That means you should not move, rename, delete, or overwrite the source file at any time between loading it into IconJack and extracting an .ICO from it. If you try, IconJack will report that the file disappeared and offer to delete that file's icons from the display.

IconJack's final function is merging any number of individual icons into a Windows .DLL file like MORICONS-.DLL. Some icon management programs use a private file format, but IconJack sticks with the standard .DLL format that Windows and Windows programs can read.

One big reason to merge icons this way is the disk space icons waste. Icon files are small, usually under 1KB, but DOS allocates disk space in clusters of 2KB, 4KB, 8KB, or more, depending on the drive's size. Thus the average icon file wastes at least 1KB of space, possibly more. For example, Visual Basic comes with almost 450 sample icons. On an unpartitioned 1GB hard disk, where each cluster is 32K, those icons will occupy 14 megabytes of disk space! If you let IconJack store those same icons as a single .DLL file, they take about 350KB.

Of course, you can collect icons from sources other than .ICO files. If you want to load every .ICO, .EXE, and .DLL file in the Windows directory and save their icons as HMNGOUS.DLL, IconJack will do the job.

Again, to get the complete image information about an icon, IconJack has to read the source file. If you've moved, renamed, deleted, or overwritten any of the source files, IconJack can't save the collection to a .DLL and will offer to delete the offending file or icon. Most of the time you'll want to press Yes and then try again to save your collection.

IconJack does not delete .ICO files after it saves their data into a .DLL. If you want to delete the files after storing them, here's an easy way. Mark the .ICO files in File Manager and drag them to IconJack. Save the resulting collection to a .DLL, and after the save operation has finished successfully, go back to File Manager and delete the marked files. Be sure you don't delete any .EXE or .DLL files along with the .ICO files!

IconJack has a capacity of 900 icons. That's the most it will display and hence the most it will merge into one .DLL. The Windows internal icon functions just won't accept a file with many more icons than that. Use the resulting .DLL in Program Manager just as you'd use MORICONS.DLL (see below for details), or use IconJack to extract individual .ICO files as needed. If you look at the file with a binary editor, you'll find the string "Icons collected by IconJack (IconJack copyright (c) 1995 by Ziff-Davis Publishing Company)" embedded in the .DLL file. Of course the copyright notice applies to IconJack, not to your collection of icons!

You can tell Program Manager to use an icon from an IconJack .DLL file without extracting the icon to an .ICO file. Here's how:

1. Highlight the existing icon in Program Manager.
2. Press Alt-Enter or choose Properties from the File menu.
3. Press the Change Icon button.
4. Press the Browse button.
5. Select your IconJack .DLL file.
6. Scroll through the icon list until you find the right one.
7. Press OK.
8. Press OK.

ORGANIZING YOUR ICONS When you use IconJack to select an .ICO file, you just dump all the .ICO files you can find into the display and browse through them. However, if you're preparing a collection for storage in a .DLL file, you'll want to delete any icons that don't suit you and put the rest in some kind of logical order. The Icon menu provides several functions to help you organize an icon collection.

Figure 2: **In this picture, the user is dragging the highlighted icon at the bottom right to a new position. The icon-drag cursor is visible just below the "NOW!" icon.**

Choose Clear to empty the display and start fresh. Delete will delete the highlighted icon; pressing the Del key has the same effect. IconJack keeps the highlight in the same place after a deletion, so you can delete several icons in a row by pressing Del repeatedly. Of course, if you delete the very last icon, the highlight moves to the new last icon.

IconJack displays its icons in an order similar to the flow of text in a multicolumn magazine article. That is, it fills the left column from top to bottom, then fills the next column from top to bottom, and so on. To change an icon's position in the list, use the mouse to drag it to the new position. When you're dragging, the cursor will change to a hand trailing a color-inverted rectangle (see Figure 2).

On a 1,024-by-768 screen with spacing as small as possible, IconJack can show over 400 icons at a time.

If the destination for the icon you're moving isn't visible, you can enlarge the IconJack window or drag the icon in several stages. You can also select Mark from the Icon menu or press Ctrl-M to mark the highlighted icon. A dotted square will appear surrounding the marked icon. Then highlight the desired destination and select Place from the Icon menu or press Ctrl-P to move the marked icon there.

EXERCISING YOUR OPTIONS The Options menu lets you customize IconJack to your own tastes. Options settings are stored in ICONJACK.INI; the position and location of the IconJack window are also stored here and reused next time you start the program.

You can set the horizontal spacing of IconJack's icons to any value from 38 to 196, and the vertical spacing anywhere from 38 to 128. Each icon will be centered in the available space. The smaller the spacing, the more icons you can see at once; the larger the spacing, the easier it is to see each one. On a 1,024-by-768 screen with spacing as small as possible, IconJack can show over 400 icons at a time!

When you choose Spacing... from the Options menu, you'll get the Icon Spacing dialog (see Figure 3). You can enter the desired spacing in the boxes at the bottom (values outside the allowable range will be forced into range). To make small adjustments up or down, you can click the spin buttons to the right of each number box. Or you can use the mouse to size the spacing box within the display rectangle.

When you change the spacing or resize IconJack's main window, the window's width will snap to a value that precisely fits a whole number of columns. If you were widening the window, it would snap up to the next full column; if you were narrowing it, the window would snap down to cut off an incomplete column.

IconJack's default behavior is to flag icons that came from .ICO files with a small capital I near their top left corner, and icons that came from Portable Executable files with a small capital P. If you just don't care where an icon came from and would like a cleaner display, remove the checks next to Mark .ICO files and Mark PE files.

Because IconJack can take a while to process a large group of files or a group of large files, it normally plays a system sound to alert you when processing is complete. It also sounds an alarm when displaying a warning message. You can turn off this audible notification by checking the Quiet item on the Options menu.

When IconJack reads icons from disk, its File Open dialog offers four file masks: *.ICO, *.EXE, *.DLL, or all three. The Options menu has four items corresponding to these four file types; only one can be checked at any given time. You're always free to choose any of the four types from the File Open dialog, but the one that's checked on the menu is what appears initially.

Figure 3: **IconJack's Icon Spacing dialog gives you three ways to adjust the icon spacing: drag a rectangle to the desired size, type the dimensions in pixels, or tweak the numbers up and down with spin buttons.**

NOT NOW—I'M BUSY! IconJack has to do a lot of work with files, and file input/output is about the slowest thing a computer does. To write a collection of icons to a .DLL, IconJack has to open the file holding each icon, read data from several locations in the file, and write the data to the .DLL. That can take up to several minutes if you've collected a lot of icons. Reading a large number of files to extract their icons can also be a relatively slow process.

IconJack is a polite Windows program; it allows other programs to process messages while it's doing this slow work. However, this also means that IconJack itself could handle other messages while doing this work. It might, for example, receive a menu selection message telling it to start another activity. Imagine the mess if you tried saving the collection to a .DLL before finishing the process of reading the icons!

To prevent that sort of problem, IconJack disables all its menu items except Help when it's busy. The cursor turns to an hourglass and the status bar indicates what's going on. IconJack signals Windows that it doesn't want to accept dropped files from File Manager at this time, too. You can move and resize IconJack's window, and you can call up the Help system; if you move the arrow to a menu item and press F1, you'll get help for that item. But you can't do anything else until IconJack is no longer busy.

PROGRAMMING ICONJACK IconJack was written using Delphi, Borland's new development environment. Building a user interface with Delphi is amazingly easy, as you'll see by examining the code for the icon-spacing dialog box. Delphi also takes a unique approach to Windows graphics, handling the most tedious and error-prone coding behind the scenes. The methods that load and display icons demonstrate this ap-

proach. At the same time, Delphi offers all the power of the Object Pascal language, so a task like decoding the file format of an .EXE or .DLL file is well within reach.

THE ICON-SPACING DIALOG BOX Figure 4 shows the code that makes IconJack's icon-spacing form tick, minus the Delphi-built object class declaration. The form contains two spin edit components (a combination spin button and number-only edit box) with labels, three bitmap buttons, and a paint box (a component designed for drawing on the form).

Any change to either of the spin edit boxes, whether from direct entry of a new value, from tweaking the spin buttons, or from a line of code in the program, triggers the BothSpinEditChange event handler method. This method forces the paint box to repaint itself any time the spin edit's value is within the allowable range. The paint box paints a rectangle whose size matches the current spacing and centers an icon in it. Simple!

The BothSpinEditChange event handler checks the spin edit box's value using the StrToIndDef function, which converts a string to an integer, returning the default value passed in its second parameter if the conversion fails. Checking the spin edit box's Value directly would seem more logical. However, Value isn't actually stored in the edit box. When you read the contents of the Value property, you're actually calling a private method called GetValue. GetValue automatically forces Value into the range specified by MinValue and MaxValue. That would be confusing; deleting the 6 from 64 would cause the text to change to 38, the MinValue. That's why this event handler avoids accessing the Value property directly.

The PaintBox1Paint method should also puzzle anyone experienced in Windows graphics programming. Normally, painting with a brush of a particular color takes several steps:

1. Create the brush.
2. Select the brush into a device context, saving the old brush.
3. Paint with the brush.
4. Select the old brush back into the device context.
5. Destroy the brush you created.

The same series of steps is necessary for other graphics objects such as pens and fonts. Delphi's graphics objects push that low-level tedium behind the scenes, where it belongs. The paint box component has a Canvas (device context) property, which has a Brush property, which has a Color property. Change that Color property and you're immediately working with a new brush of that color; Delphi takes care of the details. And drawing an icon or bitmap is a matter of calling the Draw method.

The PaintBox1DragOver method implements the drag-style resizing of the icon-spacing box. This type of event handler method receives parameters identifying the component being dragged (Source) and the component it's being dragged over (Sender). If those two are equal, it means the cursor is being dragged within the paint box. In that case, the code sets new values for the two spin edit boxes based on the *x* and *y* location of the OnDragOver event. This in turn triggers the BothSpinEditChange method, which triggers PaintBox1Paint to reflect the changed size. As you can see, in component-based programming a few lines of code can produce amazing results.

DRAWING THE ICONS IconJack's client window area is filled by an owner-drawn multicolumn list box. Storing the icons is relatively easy, because the list box component automatically manages a list of objects along with its list of strings.

The ProcessFile method is called for each file selected in the File Open common dialog box and for each file dropped onto IconJack from File Manager. It adds each filename to a string list object called Filenames and then associates the name with a user-defined object of type TFileData, which we'll examine shortly. An initialized TFileData object identifies its associated file as an .ICO file, a Portable Executable file, a normal Windows .EXE or .DLL, or an unknown type. If the file type is unknown, ProcessFile quits.

ProcessFile repeatedly calls the ExtractIcon Windows API function, requesting each icon index in turn starting from 0. It breaks out of the loop when ExtractIcon fails to return an icon handle. If an icon handle was successfully acquired, ProcessFile adds a new item to the list box along with an icon object to hold the icon. These three lines of code store the icon in the list box component:

```
Items.Objects[Ndx] := TIcon.Create;
WITH Items.Objects[Ndx] AS TIcon DO
  Handle := IcoH;
```

The actual drawing of the icons takes place in the ListBox1DrawItem method. This method first fills the specified rec-

```
procedure TIconSpacingForm.BothSpinEditChange(Sender: TObject);
begin
  WITH Sender AS TSpinEdit DO
    IF (StrToIntDef(Text, 0) >= MinValue) AND
       (StrToIntDef(Text, 0) <= MaxValue) THEN
      PaintBox1.Refresh;
end;

procedure TIconSpacingForm.PaintBox1Paint(Sender: TObject);
begin
  WITH PaintBox1.Canvas DO
    BEGIN
      Brush.Color := clBtnFace;
      Rectangle(0,0,Width,Height);
      Brush.Color := clWindow;
      Rectangle(8, 8, 8+HorzSpinEdit.Value, 8+VertSpinEdit.Value);
      Draw(8+(HorzSpinEdit.Value-32) DIV 2,
          8+(VertSpinEdit.Value-32) DIV 2, Icon);
    END;
end;

procedure TIconSpacingForm.PaintBox1DragOver(Sender, Source: TObject; X,
  Y: Integer; State: TDragState; var Accept: Boolean);
begin
  IF Source = Sender THEN
    BEGIN
      VertSpinEdit.Value := Y-8;
      HorzSpinEdit.Value := X-8;
    END
  ELSE Accept := False;
end;
```

Figure 4: **These three small methods implement the Icon Spacing dialog's multimode input.**

```
TYPE
  {Details of DOS header structure aren't important to us,
   so we just read the first 64 (40h) bytes.}
  TDOSHeader = ARRAY[0..$3F] OF Byte;

  TNEHeader = RECORD
    {New Executable file header}
    Signature                       : Word;
    LinkerVersion,
    LinkerRevision                  : Byte;
    EntryTableRelOffset,
    EntryTableLength                : Word;
    Reserved                        : LongInt;
    Flags,
    AutomaticDSegNumber,
    LocalHeapSize,
    StackSize                       : Word;
    CSIP,
    SSSP                            : Pointer;
    SegmentTableNumEntries,
    ModuleReferenceTableNumEntries,
    NonresidentNameTableSize,
    SegmentTableRelOffset,
    ResourceTableRelOffset,
    ResidentNameTableRelOffset,
    ModuleReferenceTableRelOffset,
    ImportedNameTableRelOffset      : Word;
    NonresidentNameTableOffset      : LongInt;
    NumberOfMovableEntryPoints,
    ShiftCount,
    NumberOfResourceSegments        : Word;
    TargetOS,
    AdditionalInfo                  : Byte;
    FastLoadAreaOffset,
    FastLoadAreaSectors,
    Reserved2,
    ExpectedWindowsVersion          : Word;
  END;

  ResTypeInfo = RECORD
    {Resource Type Info header}
    rtTypeId,
    rtResourceCount : Word;
    rtReserved      : LongInt;
  END;

  NameInfo = RECORD
  {Resource Table info for one resource}
    niOffset,
    niLength,
    niFlags,
    niID,
    niHandle,
    niUsage    : Word;
  END;

  IconDirEntryShort = RECORD
  {The Icon directory resource contains one or more of these}
    bWidth,
    bHeight,
    bColorCount,
    bReserved : Byte;
    wPlanes,
    wBitCount : Word;
    dwBytesInRes : LongInt;
    wID : Word;
    {In an icon resource within an .EXE or .DLL file,
     the last field is replaced by a Word that represents
     the ID of this image in the resource table.}
  End;

  IconDirEXE = record
  {Structure of the icon directory resource. The Actual number of
idEntries
    is determined by idCount.}
     idReserved : Word;
     idType     : Word;
     idCount    : Word;
     idEntries  : ARRAY[0..11] OF IconDirEntryShort;
  END;
```

Figure 5: **The New Executable file header is the key to extracting icons from .EXE and .DLL files; the other data structures are helpful along the way.**

tangle with the canvas's current brush, which has the effect of highlighting the selected item and clearing the background of unselected items. It calculates *x* and *y* coordinates that will place the icon in the middle of the rectangle. The I and P characters marking icons from .ICO files and PE files are drawn in a tiny rectangle, and then the icon itself is drawn at the calculated coordinates. If this icon is marked for moving, a call to DrawFocusRect draws a dotted border around it.

As you can see, loading icons from files, storing them in an owner-drawn list box, and drawing them on demand is really not difficult. Add the fact that the TIcon object has a SaveToFile method, and IconJack could be almost complete with just these two methods. Unfortunately, when an icon is loaded with ExtractIcon, only the image most appropriate to the current video mode is extracted. In order to get complete icon information and save .DLL files, we must dive into the complex New Executable file format.

THE NEW EXECUTABLE FILE FORMAT

The file NE header's location within the file isn't fixed, so finding it requires a kind of scavenger hunt:

1. Read the first word of the file.

If its value isn't 5A4Dh (corresponding to the characters 'MZ'), quit.

2. Read the word at offset 18h. If its value is less than 40h, quit.

3. Read the word at offset 3Ch. This should be the offset of the NE header.

4. Read the NE header at the specified offset.

5. The first word of the header is called the signature. If the signature is 4550h ('PE'), this is a Portable Executable; quit.

6. Check if the signature is 454Eh ('NE'); if it is not, quit.

If a file makes it past all these tests, the NE header reveals its most intimate details. Most important to IconJack is the ResourceTableRelOffset field, which is the relative offset of the resource table from the start of the NE header.

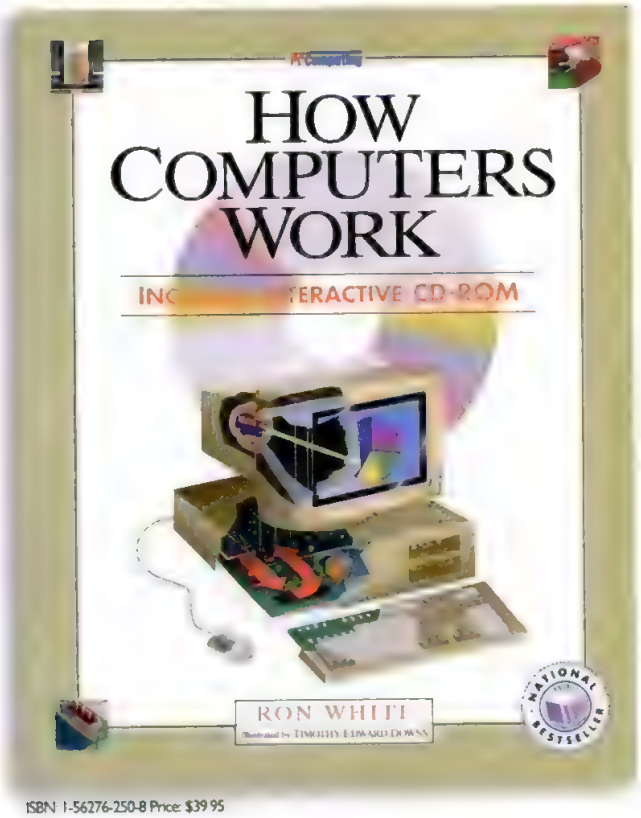
The first word of the resource table is the alignment shift count. The purpose of this value is to allow the offset of individual resources to be expressed in a two-byte word even when the file is very large. An alignment factor is calculated as 2 raised to the power of the alignment shift count, and every resource offset and length in the file is multiplied by this alignment factor.

An NE file can contain many kinds of resources, each with its own subtable in the resource table. The resources come in no specific order, but each subtable begins with a ResTypeInfo header whose rtTypeID field identifies the resource type. This is followed by as many NameInfo structures as specified in the header's rtResourceCount field. Just to make things a bit more difficult, icons are stored as two separate resource types: RT_GROUP_ICON resources are icon directory headers, and RT_ICON resources are icon images.

When you load a file's icons, IconJack initializes a TFileData object that saves information about the file, including the location of its icon resources. The complete code for TFileData is much too large to show here, but you can download it from ZiffNet (see the sidebar "Guide to Our Utilities & How to Get Them"). The InitFromExe method follows the steps described above to identify an NE file and record the location of its icon resource tables. It also records the file's size and date/time stamp.

To get the data for a particular icon, IconJack calls on the TFileData object stored with the icon's filename. The Verify method confirms that the file is still present and that its date/time stamp and size haven't changed. A call to the GetIcon-

Click Click,



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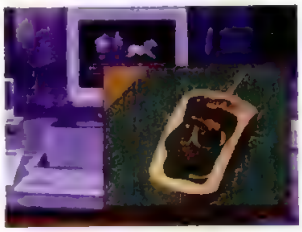

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Directory method fills a buffer with the icon directory header for the requested icon. This header's data type is IconDirEXE, and as Figure 5 shows, it's slightly different from the icon directory header for an .ICO file.

Then for each image specified in the header, a call to GetIconImage fills a buffer with the image's data. The connection between the icon-header directory resource and its image data comes through the wID field of the idEntries records in the header. If the wID field's value is, say, 25, then the required image is identified by the 25th entry in the resource table for icon images. If you've downloaded IconJack's source code, you'll find the TFileData object class definition and implementation in the unit file EXTRACTU.PAS.

You'll be amazed to see how much space you can gain by merging icons into .DLL storage files using IconJack.

CREATING A .DLL FROM SCRATCH

Most .DLL files are created by a language compiler or a compiler/linker pair, but IconJack stores icon collections in a code-free, resource-only .DLL that it builds from the ground up. IconJack first writes a standard DOS "stub." This is what produces the message "This program requires Microsoft Windows" when you try to run a Windows .EXE at the DOS command line. Next IconJack writes an NE header with most of its fields filled with data. For fields such as LinkerVersion that aren't relevant to IconJack, it uses the value found in MORICONS.DLL. The remaining fields are filled in as their values become known, and IconJack writes the completed NE header again just before closing the file.

Before adding any resources, IconJack has to estimate the final size of the file and choose an appropriate alignment shift count. Remember, in reading the re-

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source, the length and offset of each resource is multiplied by the alignment factor, so in writing the resource, the actual offset and length must be divided by the alignment factor.

Adding icons to the .DLL involves several steps. First IconJack adds all the RT_GROUP_ICON icon directory resources. It fills a NameInfo structure for the first icon directory header, using the current length of the file divided by the alignment factor as the niOffset value, and writes that NameInfo structure in the RT_GROUP_ICON resource table. Then it writes the corresponding data to the end of the file, rounding its size up to the nearest multiple of the alignment factor. To finish, IconJack repeats this process for the RT_ICON icon image resources.

IconJack is your jack of all trades for viewing, extracting, and collecting icons. You'll be amazed to see how much space you can gain by merging icons into .DLL storage files, and you'll always be able to find just the right icon for a particular application. □

NEIL J. RUBENKING IS TECHNICAL EDITOR OF *PC MAGAZINE*.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

IconJack

PURPOSE: IconJack helps you to manage, view, and select from the icons on your hard disk. It can save disk space by combining separate icon files into a single .DLL, and it lets you view as many as 900 icons at one time. You can use IconJack's editing functions to select and organize icons in your collection before saving them to a .DLL.

USAGE: To install IconJack, simply place the program files ICONJACK.EXE and ICONJACK.HLP in a directory on your hard disk. You may also want to add a Program Manager icon for IconJack.

Drag icon files onto IconJack's window from Program Manager or select File | Read Icons... from IconJack's menu. When you click on an icon, information about it will be displayed on the status bar. Selecting an icon and pressing the Del key will remove it from the collection. You can drag icons to different positions with the mouse. After rearranging your icon collection, you can save it as a .DLL by selecting File | Save Collection As DLL. To extract an icon, select it and then choose File | Save Icon as .ICO.

FILES: ICONJA.DOC is just the documentation file.
ICONJA.EXE is just the executable program files.
ICONJA.ZIP is the source code, program, and documentation files.

SUPPORT: Help for the free utilities offered by *PC Magazine* can be obtained electronically in the Utilities section of ZiffNet's Utilities/Tips forum (GO ZNT:TIPS). The authors of current utilities generally visit this forum daily. You may find an answer to your question simply by reading the messages posted in the forum. If the author is not available and the forum sysops can't answer your question, the Utilities column editor, who also checks this forum each day, will contact the author for you.

PC Magazine's utilities are available by modem from PC MagNet, our on-line service. PC MagNet is part of ZiffNet, a group of on-line services from Ziff-Davis Interactive. ZiffNet is hosted by CompuServe Information Service.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

■HARDWARE

Monitor Mix-Up?

❓ My company bought several monitors recently, and we have reason to believe that we didn't get what we paid for. We specified .28-mm dot-pitch monitors, and we believe we received something closer to .39 mm, but how can we prove it?

Many people here immediately noticed that the image on these monitors is less sharp than other monitors we have. The model number on the sticker indicates a .28-mm dot pitch, but if you stick a Cadillac sticker on a VW, it's still a VW. Is there a diagnostic tool we can use to determine the dot pitch on these monitors?

Rick Rivard
Hill AFB, Utah

▶**PC MAGAZINE:** I've never encountered a case of false monitor labeling, but it should be fairly easy to discover whether you got what you paid for. You could get a magnifying loupe with a reticule that would let you make a direct measurement, but you can get close enough for this purpose using a fairly strong magnifying glass and a ruler.

I used a single-lens magnifier with about 4x magnification and a drafting ruler with markings in tenths of an inch. (If you have an accurate ruler marked in millimeters, that would simplify the calculations.)

The key step is knowing in which direction to measure. Phosphor triads are arranged in equilateral triangles with one side oriented vertically. That means that you can't get an accurate dot-pitch measurement with the ruler aligned horizontally with the screen (at least not without resorting to trigonometry). Instead, hold the ruler vertically and line it up so you can see one column of phosphors. I found this easiest to do on a Windows screen with a full-white background; the red phosphors stood out under magnification and I was able to count them fairly consistently. A word of advice, though: Take these measurements before your second cup of coffee in the morning—the thick layer of glass between the phosphor layer and your ruler creates a parallax problem, and you need to hold the magnifying lens and your eye extremely steady while you count.

Count the number of same-color phosphors in a tenth of an inch. You need to measure across at least this much distance to reduce measurement error. On my screen I counted eight or nine phosphors, depending on how they lined up with the marks on the ruler.

The calculation is pretty easy. There are 25.4 mm per inch, or 2.54 mm per tenth of an inch. To get the dot pitch in millimeters, divide the 2.54 by the number of phosphors you count. Eight phosphors comes out to .3175 mm, and nine comes out to 28.22 mm. Obviously, this is not accurate enough to distinguish between a .30- and a .28-mm dot-pitch screen, but it will certainly show the difference from a .39-mm monitor. You'd count only six or seven phosphors in a tenth of an inch on a screen with that high of a dot pitch.

—Alfred Poor

Portable Parallel Adapter

❓ I always carry my laptop with me, and I often have to transfer files using LapLink or Interlink. I already carry a printer cable, and wanted to avoid the extra weight of a second parallel cable for file transfers. As a result, I made a female Centronics to male DB-25 adapter with the idea of being able to transform the printer cable into a file-transfer cable when needed.

Although I used a circuit tester and thought I had the connections worked out correctly, my adapter doesn't work: Neither LapLink nor Interlink can establish a connection across this combination cable.

Do you have any idea why the cable isn't working? Maybe the reason I couldn't find this type of cable for sale is because it's just not viable in the first place. If it is, though, it would be a handy device to have.

Denis Coutlee
Quebec, Canada

▶**PC MAGAZINE:** I've never seen such an adapter either, but it makes a lot of sense to me, too. I don't see any reason why your adapter shouldn't work unless some of the connections are wrong. Here's a table of connections that you need:

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PC DIRECT

PC DIRECT starts here with exciting offers from top direct vendors.

See index, page 280.

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6	11
10	5
11	6
12	4
13	3
32	2
19-32	25

Note that pins 19 through 32 at the Centronics end are wired together and then connected to the DB-25 through a single conductor. If you have a portable printer, or if you routinely carry a printer cable for your laptop, this adapter should be a handy and lightweight addition to your kit.—*Alfred Poor*

Our Advisors

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT.COM and EMS40.SYS.

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M. David Stone is a contributing editor and coauthor of *Word for Windows Companion,* Second Edition.

Perplexing Pauses

❓My computer has a choking problem. It stops for no reason at all for 15 to 45 seconds and then continues whatever it was doing before. This happens with every application. For example, an icon in Ami Pro will stay pressed in for 40 seconds or so and will then pop back and do whatever it was supposed to do.

These problems started after I upgraded my computer, so I think that there must be some crazy interrupt switched off instead of on, some magical line missing from SYSTEM.INI, or some other esoteric detail out of whack. My new system has a PCI motherboard with a 66-MHz Intel 486DX2, 8MB RAM, 545MB IDE hard disk (which makes funny noises all the time, unlike the absolutely quiet 212MB IDE disk in my old system), no sound card, and a double-speed CD-ROM. Can you help?

Ross Hedvicek
via the Internet

▶PC MAGAZINE: The key may prove to be the "funny noises" coming from the hard disk. If your hard disk has some marginal sectors, it could be reading repeatedly in order to get a good read, and the pauses are these repeated reads until the hard disk succeeds and starts up again.

If the pauses occur during a number of Windows applications, a disk flaw could still be the cause. Even with 8MB of memory, it is still quite possible that you're using the Windows virtual-memory swap file. If the flaw is within that file, it could be the sore toe that your computer keeps stubbing, leading to the pauses.

The best place to start is to run a good disk diagnostic. As with any procedure that can change your disk's data structure, be sure to create a complete backup of all essential data before you start. Then, for the time being, use the Control Panel to eliminate the permanent swap file. After doing this, use SCANDISK, which comes with MS-DOS 6.22, or any other similar program. Be sure to run a complete surface scan for your hard disk. If you find any bad or weak sectors, let the program lock them out. Then restore the permanent swap file. If SCANDISK does locate some bad sectors, defragment your hard disk before re-creating your permanent swap file to make sure you can create as large a swap file as possible.—*Alfred Poor*

HOW TO CONTACT US

Do you have a hardware, software, or systems problem you can't solve? Do you have a tip you think other readers could use? Perhaps you'd like a better understanding of how something works. If so, we invite you to tell us about it. Our experts can give you practical solutions to your problems, provide techniques for using your software and hardware more productively, and help you grasp computer concepts and understand the latest technology.

It's easy to contact us. Just send us your submission (use ASCII format for text files) via the medium that's most convenient for you:

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For any tip we print, you'll receive $50 plus a *PC Magazine* T-shirt. We regret that we cannot answer letters individually.

WORD PROCESSING

Using Word's Macrobutton Fields

❓ I'm trying to create a document that uses Microsoft Word 6.0's Macrobutton fields to launch another application and

Mr. Boddy has been murdered, and his killer remains at large. But sometime today before the scheduled 8:00 p.m. reading of Mr. Boddy's last will and testament, the Murderer will change the document to read in his or her favor.

Unfortunately Boddy's closest living relative, Mr. Green, is out of town on business and was not informed of his cousin's death. But those who have gathered at the Boddy mansion for the reading include Mrs. Peacock, his accented Sister-in-law; Colonel Mustard, an old army buddy; Professor Plum, a dear friend and classmate during his days at Yale; Miss Scarlet, a "special friend"; and Mrs. White, his loyal servant of 25 years.

Please help us find the killer by determining who changed the will... where... and with what...

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The SoundBook II With Convenience Is Served

Personality Modules...

7:45 p.m. and tensions are high. The anticipated reading of the will is only minutes away. But with so many unique personalities in one room... MidWest Micro's SoundBook II should feel right at home!

When the main course is murder, people tend to lose their appetite—but they still hunger for convenience. And that's where the ***NEW*** SoundBook II comes in. Featuring a programmable Personal TouchPad, two RAM compartments and a modular design, this MidWest Micro Notebook is dressed to kill. So before we interrogate the other suspects at the table, let's investigate the SoundBook II...

Powerful Features...Weak Alibi

Who *knows* where this portable was on the night in question? Weighing only 6 lbs., it could have gone *anywhere*! Some eyewitnesses claim they saw the SoundBook II with a built-in floppy drive at 6:37 p.m. While another source swears the same drive bay was carrying an AC adapter at precisely 6:40! What makes the SoundBook II such a master of disguise?—It uses special compact peripherals, A.K.A. Personality Modules, that fit its modular 3.5" drive bay. Enjoy the floppy drive and AC adapter modules that come with your SoundBook II. And feel free to order additional modules like a 3.5" CD-ROM drive, a 14.4 Kbps voicemail fax modem, an extra hard drive and an extra battery.

Evidence Stacked In Your Favor

If *speed* is your motive, you may want to check out MidWest Micro's Pentium™ Processor Based SoundBook Plus. Like the SoundBook II, it comes with 16-bit stereo audio and built-in speakers. But this SoundBook *also* features a 75 MHz or 90 MHz Intel® Pentium Processor. And if you think *that* sounds like a setup, get a load of The Real Warranty. It covers all MidWest Micro Notebooks for a full three year sentence—parts *and* hard labor included! We can only assume that Mr. Boddy (being of sound mind) would have loved both MidWest Micro SoundBooks.

Contributing To The Delinquency Of A Diner?

Although it's unlikely that these MidWest Micro Notebooks are capable of murder, they *may* be found guilty of aiding and abetting. In fact, one of these guests may have already used a SoundBook to change Mr. Boddy's will... Perhaps Mrs. Peacock is doing it *right now*!—Or maybe she's just playing a little Microsoft® Golf.

Since we have a little time before Mr. Boddy's lawyer arrives, let's reconstruct another way this heinous crime may have been committed...

" Fastest portable we've ever tested, a fine desktop replacement"
— *PC World*, April 1995

" MidWest Micro wowed us with its Elite Pentium SoundBook Plus, the first Pentium-90 notebook we've tested; its performance blows every other reviewed mobile out of the water."
— *PC World*, March 1995

" ...produced the highest Winstone 95 score of all reviewed systems"
— *PC Magazine*, January 1995

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Colonel Mustard

In The Kitchen With A MidWest Micro PC?

"It's darn fast and darn cheap."
— *PC Computing*, April 1995

"The Elite P5-90 is one of the fastest computers we've tested."
— *PC World*, January 1995

PC WORLD TOP 20 Power Desktops

"I can't believe these people didn't put lunch on the itinerary," the Colonel grumbled. "And you would ***think*** *a person with this much money could afford better lunch meat." Was it merely hunger pains that brought Colonel Mustard into the kitchen this afternoon? Or was it Mr. Boddy's MidWest Micro Home PC…* ***and revenge!…***

Mustard hadn't touched a computer since his code cracking days in the Middle East. But this "MidWest Micro Home PC" looked nothing like *that* relic. Typing in the secret password with his one good hand, the Colonel checked his watch again. He knew exactly how long it would take the IntelDX4™ 100 Processor to find the will, make the changes and save them on the Home PC's 850 Mb hard drive. "Not bloody long at all," he said with a smirk.

Colonel Mustard had planned his strategy very carefully. And after reading six computer magazines cover-to-cover, he learned that MidWest Micro Desktop Systems are available with Intel486™ and Pentium™ Processors, double- and quad-speed CD-ROM drives, voicemail fax modems and hard drive capacities up to 1.6 Gb! And whether you order a multimedia-packed Home PC or an Office PC stocked with powerful business software, you should always expect an ambush of high performance. But even nine weeks at boot camp, two wars and a Purple Heart didn't prepare the Colonel for what he was about to witness…

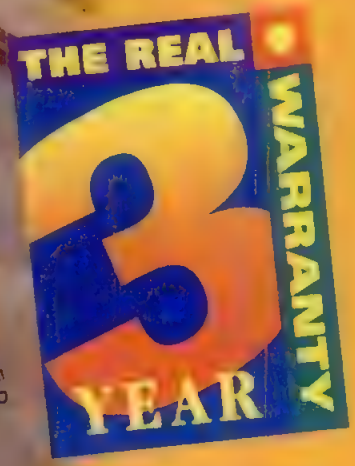
Opening the Home PC's Microsoft® Family Bundle, Mustard found an arsenal of interactive CD-ROM software—Encarta™ 95, Works, Money, Scenes, Dangerous Creatures and Golf were his to conquer. Before he knew it, the 15" color screen had exploded into multimedia mutiny. And he was even *more* impressed with Microsoft Bob™. Featuring eight household management programs in one efficient package, this new recruit had all the makings of a great soldier.

By this time the Colonel was distracted from his original covert operation. So he set a course for the library to see what Mr. Boddy's *120 MHz Office PC* had to offer…

Who killed Mr. Boddy and changed his will? The rest of the investigation is up to you…

To find out "who dun it" and receive a [illegible] catalog dial 1-[illegible].

Systems may also include:



Microsoft Home

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- 4 ISA, 2 PCI & 1 PCI/ISA Slots
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- Microsoft Mouse
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- EPA Energy Star Compliant
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- Microsoft Complete Baseball CD
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#008759

P5-120 PCI $3499
#008760

P5-100 PCI $3599
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- 4 ISA, 2 PCI & 1 PCI/ISA Slots
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- Microsoft Mouse
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intel inside pentium

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- MS-DOS 6.22 & WFW 3.11
- Microsoft Works for Windows 3.0 & Golf
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- Weight: 6.0 lbs.
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Dual-Scan Color

DX4-75 with 340 Mb HDD
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intel inside

Options

Personality Modules		
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– Battery	Call	Call
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PCMCIA 14.4 Fax Modem	#002624	$129
PCMCIA Combo Ethernet Adapter	#001954	$139
PCMCIA Panasonic Double-Speed CD-ROM Drive	#003728	$295
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AD#G07

CIRCLE 398 ON READER SERVICE CARD

open a specific file in one step. The only solution that Microsoft technical support says will work, however, requires a separate step to open the files.

The field I'm using to start Excel, for example, is

```
{MACROBUTTON MicrosoftExcel
 {EMBED MSDraw}}
```

I created an embedded drawing in MS Draw so that the field result looks like a button. When I click on this field, it calls up Excel all right, but that still leaves me with the tedious task of separately loading the particular spreadsheet I want to work with.

I know that I could use OLE to embed files in the document, but the spreadsheets and database tables I need to call up are huge, and it's not really appropriate to display them in the document in any case. Is there any way to build a button in Word that will bring up a program and load a specific file?

Timothy R. Fisher
Beaverton, Oregon

▶PC MAGAZINE: It's actually easy to launch a program and load a specific file at the same time. But the way to begin is with a macro. Once you've created the appropriate macro, you can use a Macrobutton field to run it. (You could use OLE to *link* the file instead of embedding it, which will increase file size by only a few thousand bytes, and you can choose to display the linked file as an icon rather than see the embedded spreadsheet. The Excel icon can then function as a button. But using a macro with a Macrobutton field eliminates the need for *any* significant increase in file size and offers more flexibility.)

Before discussing the macro you need, it's worth discussing Macrobutton fields for those who aren't familiar with them. Briefly, as the name implies, a Macrobutton field is a Word field—much like a date or a time field—that you can use to run either a macro or a Word command. The field takes the form:

```
{Macrobutton MacroOrCommand
 TextOrDrawing}
```

MacroOrCommand is the macro or command that the Macrobutton field will run when you double-click on it or select the field and type Alt-Shift-F9. TextOrDrawing is the text or drawing that Word will show as the field result. For all practical purposes, it's the button to select or click.

You can create a Macrobutton field in much the same way as you'd create any other standard Word field. If you like, you can choose Insert Field and pick your way through the field dialog box to enter the field. Alternatively, you can press Ctrl-F9 to insert the field markers, which look like curly braces, and then enter the text for the field between the markers. You can use text, an inserted picture, or an embedded drawing for the button itself. Once you've entered either the text or the picture, you can see the finished button by placing your cursor or selection in the field and typing Shift-F9 to see the field result.

To create a button using text, simply type in the text for TextOrDrawing and format it to taste. If the field is in a para-

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486DX4/75	10.4" Active	510MB	5029
486DX4/75	10.4" Active	810MB	5389

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486DX2/66	10.4" Dual Scan	510MB	2259

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486DX4/75	10.3" Dual Scan	510MB	2749
486DX4/75	10.3" Dual Scan	700MB	3049
486DX4/75	10.4" Active	510MB	3829
486DX4/75	10.4" Active	700MB	4129

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Desktop	Pentium100	1.28GB	2419
Minitower	Pentium75	1.28GB	2299
Minitower	Pentium100	1.28GB	2759

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Desktop	Pentium 75	1.08GB	1979

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Processor	Screen	HD	Price
486DX4/100	10.4" Dual Scan	340MB	$4099
486DX4/100	10.4" Dual Scan	540MB	4449
486DX4/100	10.4" Dual Scan	810MB	4899
486DX4/100	10.4" Active	340MB	4999
486DX4/100	10.4" Active	540MB	5349
486DX4/100	10.4" Active	810MB	5799
486DX4/100	10.4" Active	540MB	6349*
486DX4/100	10.4" Active	810MB	6799*
Pentium 75	10.4" Active	540MB	CALL
Pentium 75	10.4" Active	810MB	CALL

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486DX2/50	8.4" Active	340MB	3099
486DX2/50	8.4" Active	540MB	3449

Processor	Screen	HD	Price
IBM ThinkPad® 701			
486DX2/50	10.4" Active	360MB	$4799
486DX2/50	10.4" Active	540MB	5149
486DX4/75	10.4" Dual Scan	360MB	4399
486DX4/75	10.4" Dual Scan	540MB	4749
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486DX2/50	8.4" Active	330MB	2699

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Processor	Screen	HD	Price
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486DX4/75	9.5" Active	500MB	$3099
T4850CT			
486DX4/75	10.4" Active	500MB	$3199
486DX4/75	10.4" Active	772MB	3349
T3600			
486DX2/50	8.4" Active	500MB	$3239

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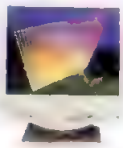

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CC4144	14.4/14.4 PCMCIA GOLD	209.99
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HP OmniBook 4000 Notebook PC

HP OmniBook 600

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- Built-in infrared for no hassle printer connections
- Instant "ON" resume feature - lasts up to 1 week

Processor	Screen	HD	Price
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486DX2/50	8.5" Dual Scan	260MB	2549
486DX4/75	8.5" Dual Scan	170MB	2869
486DX4/75	8.5" Dual Scan	260MB	3049

HP OmniBook 4000

- 10.4" Active & 10.3" Dual Scan
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- Replace floppy w/ 2nd battery for 5-7 hrs battery life
- Built-in infrared for no hassle printer connections

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486DX2/50	10.3" Dual Scan	520MB	3019
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486DX2/50	10.4" Active	520MB	3699
486DX4/100	10.3" Dual Scan	340MB	3259
486DX4/100	10.3" Dual Scan	520MB	3549
486DX4/100	10.4" Active	340MB	3819
486DX4/100	10.4" Active	520MB	4099

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NEC

Versa M

Versa P

Versa M

- High Res. displays avail. - 800x600 res on notebook
- True colors displays available-16.7 million colors on notebook
- Removable/Reversible display
- Replace floppy w/ 2nd battery for 6-10 hrs. battery life
- Replace floppy w/ Versa Bay - Add extra PCMCIA
- Built-in 16-bit sound, microphone & speaker
- Upgradable hard drive - easily add more storage

Processor	Screen	HD	Price
486DX4/75	9.5" Dual Scan	250MB	$2649
486DX4/75	9.5" Dual Scan	340MB	2739
486DX4/75	9.5" Active	340MB	3169
486DX4/75	9.5" Active	540MB	3449
486DX4/75	9.5" True Color	340MB	3449
486DX4/75	9.5" High Res.	540MB	3829
486DX4/100	9.5" Active	340MB	3639
486DX4/100	9.5" True Color	540MB	4199
486DX4/100	9.5" Active	810MB	4299
486DX4/100	9.5" High Res.	540MB	4299
486DX4/100	9.5" High Res.	810MB	4679

Versa P

- 75MHz Pentium - for blazing performance
- High Res. displays available - 800x600 res on notebook (10.4" on selected models)
- Removable/Reversible display
- Replace floppy w/ 2nd battery for 6-10 hrs battery life
- Replace floppy w/ Versa Bay - Add extra PCMCIA
- Built-in 16-bit sound, microphone & speaker
- Upgradable hard drive - easily add more storage

Processor	Screen	HD	Price
Pentium 75	9.5" Active	340MB	$4349
Pentium 75	9.5" Active	540MB	4629
Pentium 75	9.5" Active	810MB	4999
Pentium 75	9.5" High Res.	540MB	4999
Pentium 75	9.5" High Res.	810MB	5389
Pentium 75	10.4" Active	540MB	4999
Pentium 75	10.4" Active	810MB	5389
Pentium 75	10.4" High Res.	810MB	5769

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Minitower	Pentium 75	850MB	1999
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Minitower	Pentium 90	1.2GB	2699
Minitower	Pentium 100	1.2GB	2999

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- Replace floppy w/ 2nd battery for 6-10 hrs battery life
- Upgradable hard drive - easily add more storage
- 32-bit local bus with 1MB video RAM
- 64K colors on notebook display (Active only)

Processor	Screen	HD	Price
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486DX2/50	9.5" Dual Scan	340MB	2359
486DX2/50	9.5" Active	250MB	2359
486DX2/50	9.5" Active	340MB	2599
486DX2/50	9.5" Active	540MB	2879
486DX4/75	9.5" Active	340MB	2789
486DX4/75	9.5" Active	540MB	3069
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- User Replaceable 772MB Hard Drive (Active)
- User Replaceable 500MB Hard Drive (Dual Scan)
- Infrared port for wireless connections

Processor	Screen	HD	Price
Pentium 75	10.5" Dual Scan	500MB	$4999
Pentium 75	10.4" Active	772MB	5599

TravelMate 4000M

- Brilliant color display
- 16 bit sound card
- Integrated pointing device
- 2 Type II or 1 Type III PCMCIA slot

Processor	Screen	HD	Price
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486DX4/75	9.5" Dual Scan	455MB	2459
486DX4/75	8.4" Active	340MB	2729
486DX4/75	8.4" Active	455MB	2979
486DX4/100	9.5" Active	525MB	3939

75MHz Pentium with PCI BUS

TravelMate 5000

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graph by itself, you can make it look more like a button by formatting the paragraph with borders and setting the paragraph width to match the length of the text line. If the button is within a paragraph of text, you can make it stand out by formatting it in a font different from the surrounding text or by making it a different color, as with the hypertext links in a typical Windows help file.

Creating a button with a drawing is also straightforward. Instead of typing text, you simply insert the drawing. If the drawing already exists as a file on disk, choose Insert Picture, specify the file to use, and choose OK. If it doesn't exist as an independent file on disk, choose Insert Object, choose an Object type to insert, and then create the drawing in the linked program. MS Draw, which Mr. Fisher used, is an OLE applet that came with Word 2.0, which you may still have on your disk if you upgraded to Word 6.0 from Word 2.0. The equivalent tool in Word 6.0 is Microsoft Picture. Assuming you installed the program when you installed Word, it will show up on the Object Type list as Microsoft Word 6.0 Picture.

The macro for launching the program and loading a specific file at the same time needs only a single Shell statement to do its work. The command takes the following form

```
Shell "CommandLine"
```

where CommandLine launches the program. To start Excel and load the file SAMPLE.XLS from the C:\CALCDATA directory, for example, the Shell command would read

```
Shell "Excel C:\CALCDATA\SAMPLE.XLS"
```

To create the macro, simply choose Tools | Macro, enter an appropriate macro name such as ExcelSample, choose Create, and then enter the Shell command line between the Sub MAIN and End Sub statements. Then close the macro window and answer Yes when Word asks whether you want to save it. (And don't forget to save the macro to disk by using the Save All command to save the changed template.)

One important note: For the Shell command to work, it must be able to find the program you want to run. If the program directory is included in your path statement in AUTOEXEC.BAT, you can simply give the program name, as in the example. If not, you'll need to give the entire drive and path name in the Shell command.—*M. David Stone*

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SPREADSHEETS

Changing Excel ToolTip and Status Bar Text

? How can I specify the ToolTip text and status bar message for my custom toolbar icons in Excel? The only ToolTip I can get for a custom macro icon is "Custom," and the only description I can get in the status bar is "Creates a button to which you can assign a macro." Is there any way to change these?

Jay Armstrong
Pensacola, Florida

▶PC MAGAZINE: Yes. To change the ToolTip text for a toolbar button, you need to modify the button's Name property. Let's say your custom icon is the 27th button on the Standard toolbar, and you want to call it "Update Chart." You could do that by entering the following statement on one line in a Visual Basic, Applications Edition (VBA) macro:

```
Toolbars("Standard").Toolbar-
buttons(27).Name="Update Chart"
```

If you don't feel like writing a full-fledged macro, do it this way:

1. Choose Macro from the Insert menu, then Module from the submenu.
2. Type Ctrl-G to open the VBA "immediate" window.
3. Type the VBA statement above.
4. Close the immediate window and return to your worksheet.

Once you change a tool's name property, it stays changed until you change it again.

You do have to be careful, however, when identifying the tool whose name you want to change. Count the gaps as well as the tools. On the default Standard toolbar, for example, the Print tool is the fourth icon, but it is considered toolbar button number 5, because there's a gap between the Save tool and the Print tool. To verify that you've counted correctly, you might want to check the name property of the tool on either side of your custom tool. For example, if you think your custom tool is number 27, you could type the following on one line in the immediate window:

```
Print Toolbars("Standard").Toolbar
buttons(26).Name
```

VBA will display the name of the 26th tool, allowing you to confirm that the tool yours follows is the one you think it follows.

The VBA statement must include either the name or the number of the toolbar, as well as the number of the toolbar button you're naming. I've used "Standard" in the examples above, but you could also write Toolbars(1), because the Standard toolbar is toolbar number 1. The default numbering and naming scheme is as follows:

Number	Name
1	Standard
2	Formatting
3	Query and Pivot
4	Chart
5	Drawing
6	TipWizard
7	Forms
8	Stop Recording
9	Visual Basic
10	Auditing
11	Workgroup
12	Microsoft
13	Full Screen

But you needn't memorize this list. Choose Toolbars from the View menu. The toolbar list that appears adheres to this order, so you can just count down to the bar you're interested in.

So much for ToolTips. The status bar

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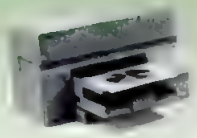

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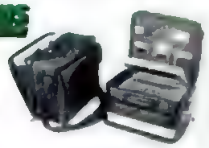

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text is actually a property of the macro to which your tool is assigned. You can change this text as follows:

1. Choose Macro from the Tools menu.
2. Select your macro from the list that appears.
3. Click the Options button.
4. In the dialog box that appears, enter your text in the Status Bar Text edit box.

Oddly enough, the Options button in the Record New Macro dialog box does not include a Status Bar Text edit box. So if you want to specify the text by filling out a dialog box, you have to do it after you've created your macro. Alternatively, you can add a line of code to the macro itself. For example, if your macro is called UpdateChart and you want the status bar to say "Add new data to the chart," you can write the following line:

```
Application.MacroOptions macro:=
"UpdateChart", StatusBar:="Add new
 data to the chart"
```

You can put this line anywhere in the UpdateChart macro—or in any other macro. Like the ToolTip text, the status bar text stays put from session to session once you've specified it.—*Craig Stinson*

DATABASES

Changing FoxPro System Memory Variables at Startup

❓ I've been frustrated by my inability to change the default settings of system variables in FoxPro. As an example, I'd like to load FoxPro with the system variable _PEJECT set to "AFTER" rather than "BEFORE," which is the default setting. This is particularly annoying because when I choose the File Menu and select Print, I always have to change the print eject setting manually.

Adding the statement

```
_PEJECT="AFTER"
```

to the CONFIG.FP file doesn't do it; the statement is apparently ignored. Where are all the system variables stored so that I can get at them and change their default values to suit my taste?

The only way to change these variables now, it seems, is in the Command window at the beginning of a session or inside a coded program.

Nick Wolff
Hanover, New Hampshire

▶**PC MAGAZINE:** The CONFIG.FP file (or CONFIG.FPW in FoxPro for Windows) is used to change the startup values for certain FoxPro memory variables and settings. Unfortunately, determining just what settings can be set in the CONFIG file always seems to be a trial-and-error exercise. There's no apparent rhyme or reason to why some things can be set while others cannot.

Anyway, I always add the following line to my CONFIG.FP or CONFIG .FPW file:

```
COMMAND = DO CONFIG.PRG
```

This tells FoxPro to execute the CONFIG.PRG program file automatically at startup. The CONFIG.PRG file is an ordinary FoxPro program, so you can put pretty much anything you want in there. Figure 1 shows a sample CONFIG.PRG that displays some status information in the main FoxPro window whenever FoxPro starts up.

FoxPro's system memory variables are stored somewhere deep within FoxPro, but you can change their startup values within the CONFIG.PRG program. Although FoxPro allows it, don't bother putting multiple COMMAND= lines in your CONFIG.FP, because FoxPro ignores all but the last one.
—*Sal Ricciardi*

```
SET TALK OFF
CLEAR
? version(1)
oldc = SET("CENTURY")
SET CENTURY ON
? "Today is "+MDY(DATE())
SET CENTURY &oldc
? "Config file is "+SYS(2019)
? "Resource file is "+SET('RESOURCE')
? "Resource file is "+SYS(2005)
IF ""==ALLTRIM(_PDSETUP)
  ? "No printer driver installed"
ELSE
  ? "Printer driver is "+_PDSETUP
ENDIF
? "Default is "+SYS(5)+SYS(2003)
? "Path is "+SET('PATH')
? "Library is "+SET('LIBRARY')
? 'Curdir is '+SYS(5)+CURDIR()
ON KEY LABEL "RIGHTMOUSE" KEYBOARD "{ENTER}"
_PEJECT="After"            && Set the _PEJECT variable
? '_Peject='+_PEJECT
```

Figure 1: **This is a sample CONFIG.PRG file that displays useful information whenever FoxPro starts up. You need the line COMMAND=DO CONFIG.PRG in your CONFIG.FP or CONFIG.FPW file to tell FoxPro to run the CONFIG.PRG file at startup.**

Access Shortcuts for Selecting Forms or Reports

❓ When you're in the Form or Report design mode of Microsoft Access, you often need to select the entire form or report. One way to do this is to click on the white box in the top left corner of the form or report. Another way is to click on the space to the right of your form or report, or below the form or report footer. For example, to change a form- or report-level property, you can double-click on any of these areas to bring up the properties sheet.

In Access 2.0 you can also double-click on the ruler, as long as there are no objects directly below that point.

Shane Devenshire
Walnut Creek, California

▶**PC MAGAZINE:** Clicking on the white square in the upper-left corner of the design window was news to me, but it's actually documented in the help for Microsoft Access 2.0 if you happen to look up the Select Form/Select Report command (Edit menu). Two mouse techniques for selecting the form or report are listed:

- Click in the square where the rulers meet.
- Click the gray area outside the form or report.

Both are shortcuts for selecting the Edit menu and choosing Select Form (or Report). Double-clicking the square where the rulers meet seems like a nice, consistent way to bring up the top-level properties sheet. □
—*Sal Ricciardi*

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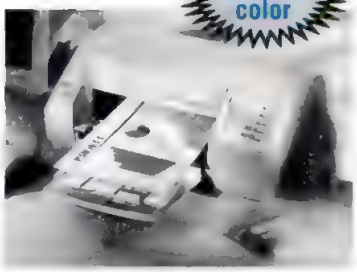

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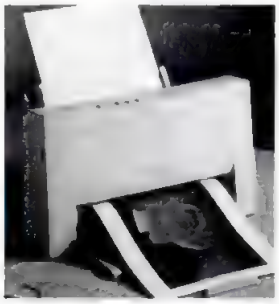

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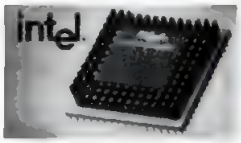

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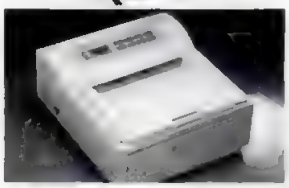

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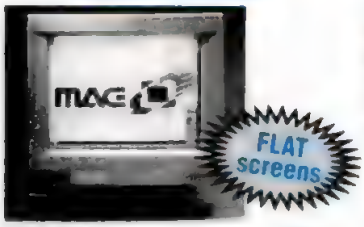

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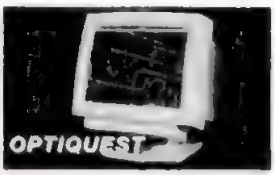

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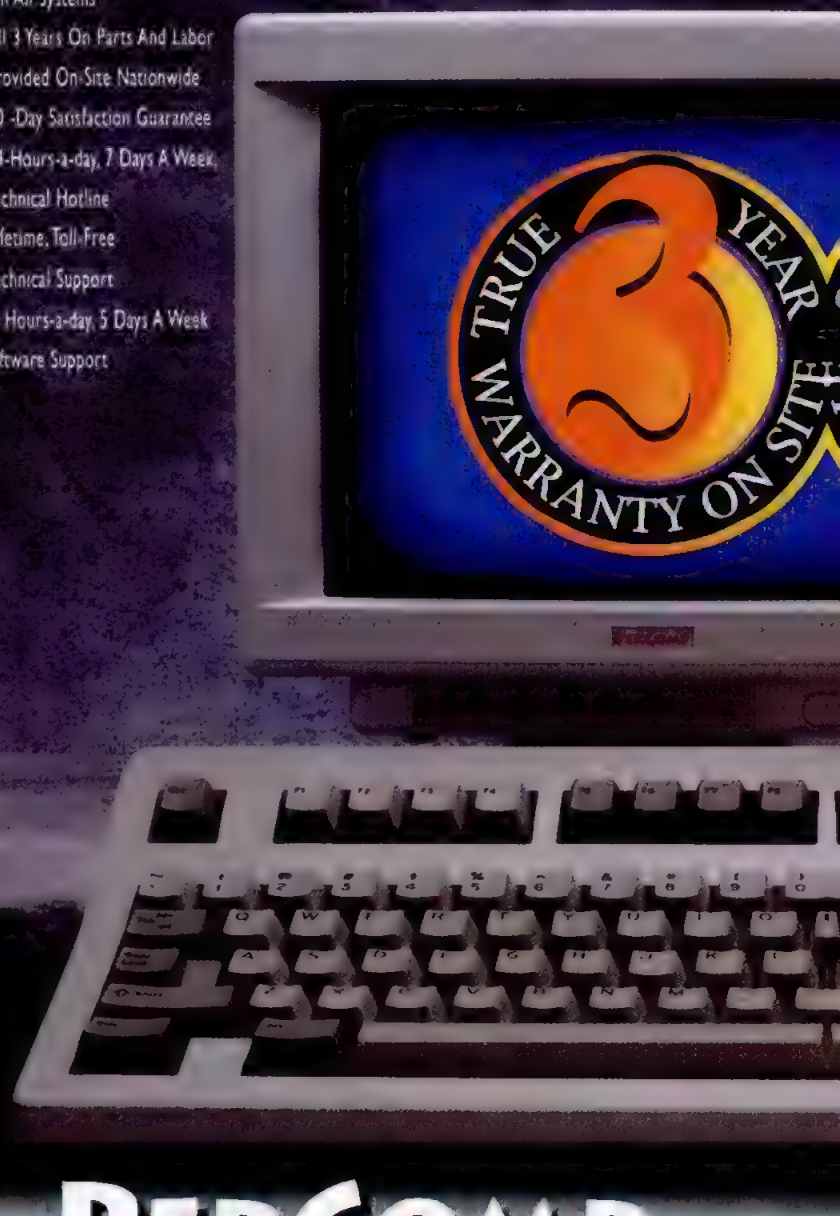

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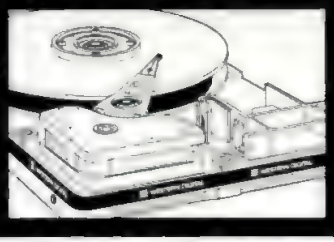

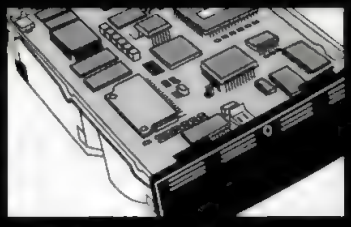

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1.3Gig	Maxoptix	23ms	4MB	1yr	$2149

NEC

540MB	12ms	4500rpm	IDE	2yr wty.	$179
730MB	11ms	4090rpm	IDE	2yr wty.	$212
1083MB	11ms	4090rpm	IDE	3yr wty.	$319
1083MB	11ms	4090rpm	SCSI	3yr wty.	$399

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1278MB	14ms	CFS1275A	$365
SCSI			
1080MB	11ms	CFP1080S	$469
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2147MB	9ms	ST32430N	$885
2147MB	8ms	ST32550N	$979
4290MB	9ms	ST15230N	$1289
4290MB	8ms	ST15150N	$1489
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731MB	11ms	LT730A	$245
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SCSI			
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545MB	12ms	FB540S	$260
731MB	11ms	LT730S	$259
850MB	14ms	TB850S	$279
1050MB	12ms	FB1080S	$519
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Toshiba	XM3501	4X	155ms	$299
NEC	CDR4X	4X	220ms	$325
Plextor	PX43CS	4X	170ms	$339
Sanyo	SH254S	4X	190ms	$239
Sony	CDU55S	2X	250ms	$159
Sanyo	SH93R	2X	280ms	$149
PIONEER SCSI CD ROM CHANGERS				
DRM602X	6Disc	2X	300ms	$399
DRM624X	6Disc	4X	190ms	$729
DRM1804X	18Disc	4X	300ms	$1899
IDE (ATAPI)				
Mitsumi	CRMCFX400	4X	230ms	$185
Sony	CDU50A	2X	250ms	$119

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2Gig	Conner	CTD2000	$779	$879
2-4Gig	Conner	TSM4000	$539	$609
2-4Gig	Conner	CTD4000	$849	$949
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A1542COREL 16Bit	$235	$225
A2742 EISA	$379	$369
A2842 VESA	$259	$249
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DC300B 16Bit	$159	$149
DC800B 16Bit Caching	$199	$189
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Future Domain 1680 16Bit	$134	$119
QLOGIC PCI SCSI & WIDE	$325	$315

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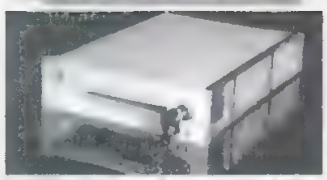

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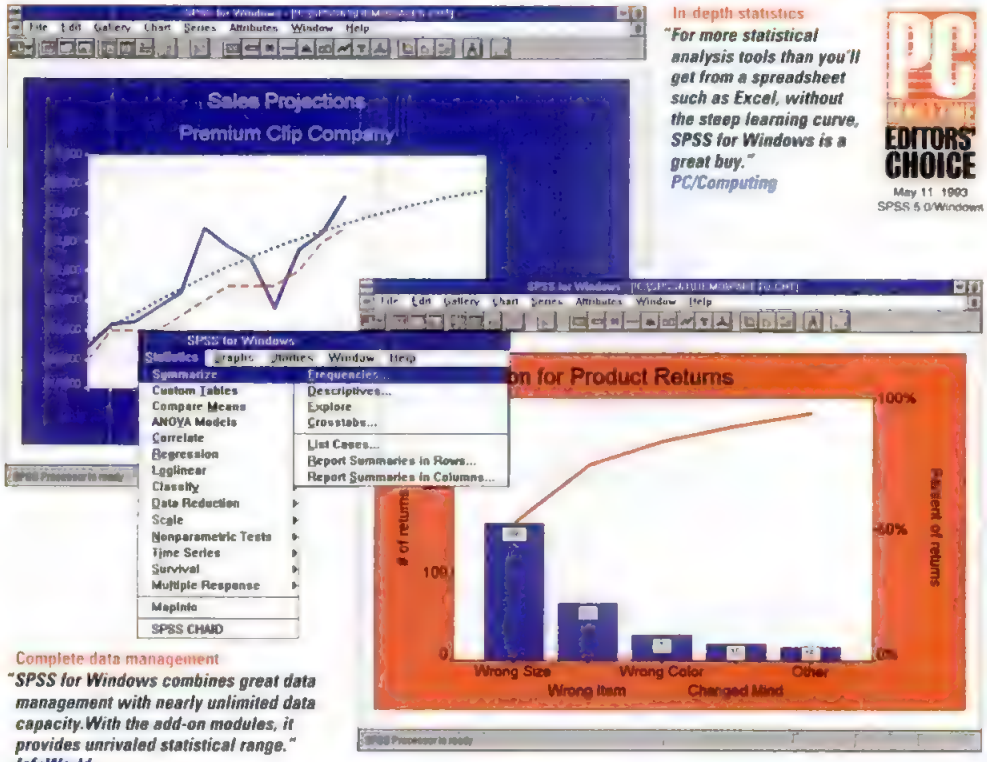

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T2100CS	486DX2/50	4MB	10.4" Dual Scan	330MB	$2162
T2100CT	486DX2/50	8MB	8.4" Active	330MB	$2675
T2150CDS	486DX4/75	4MB	10.4" Dual Scan	500MB	$3059
T2150CDT	486DX4/75	8MB	10.4" Active	500MB	$3657
T2400CS	486DX2/50	4MB	9.5" Dual Scan	250MB	$2031
T2400CS	486DX2/50	4MB	9.5" Dual Scan	320MB	$2159
T2400CT	486DX2/50	8MB	8.4" Active	250MB	$2530
T2400CT	486DX2/50	8MB	8.4" Active	320MB	$2708
T2450CT	486DX4/75	8MB	8.4" Active	320MB	$3102
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486DX4/75	8MB	10.3" Dual Scan	510MB	$2606
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486DX2/50	4MB	9.5" Dual Scan	340MB	$2327
486DX2/50	4MB	9.5" Active	250MB	$2327
486DX2/50	4MB	9.5" Active	340MB	$2560
486DX2/50	4MB	9.5" Active	540MB	$2840
486DX2/50	4MB	10.1" Active	340MB	CALL
486DX4/75	4MB	10.1" Active	540MB	CALL
486DX4/75	4MB	9.5" Active	340MB	$2747
486DX4/75	4MB	9.5" Active	540MB	$3026

ASCENTIA 810N

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- Dual battery capability
- 10.4" DualScan STN color display

Processor	Ram	Screen	Hard Drive	Price
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486DX2/66	4MB	10.4" Dual Scan	340MB	$2002
486DX2/66	4MB	10.4" Dual Scan	510MB	$2141

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NEC

Processor	Ram	Screen	Hard Drive	Price
486DX4-75	8MB	9.5" Dual Scan	250MB	$2997
486DX4-75	8MB	9.5" Active	340MB	$3678
486DX4-100	8MB	9.5" Active	340MB	$4003
486DX4-100	8MB	9.5" Active	810MB	$4655

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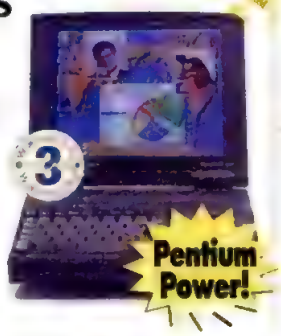
4000M	486DX2/50	4MB	8.4" Active	455MB	$2343
4000M	486DX4/75	4MB	9.5" Dual Scan	455MB	$2427
4000M	486DX4/75	4MB	8.4" Active	340MB	$2678
4000M	486DX4/75	4MB	8.4" Active	455MB	$2930
4000M	486DX4/100	4MB	9.5" Active	525MB	$3850
5000M	Pentium 75MHz	8MB	10.5" Dual Scan	500MB	$4939
5000M	Pentium 75MHz	8MB	10.4" Active	772MB	$5525



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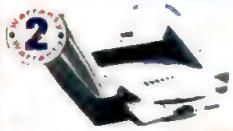

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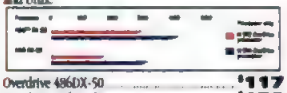

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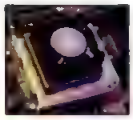

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Most applications run satisfactorily with 8MB, but in the long run 16MB is recommended

- Memory allows Windows & OS/2 to run faster
- Reduces your system's need to access the hard disk
- Utilize numerous & extensive applications at the same time

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Z-Sport 325S	4MB	[illegible]
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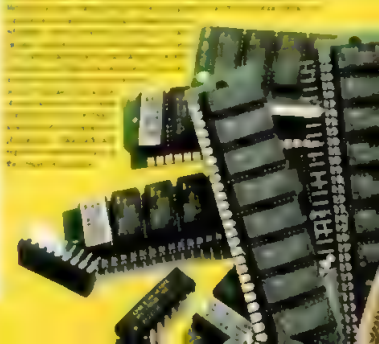

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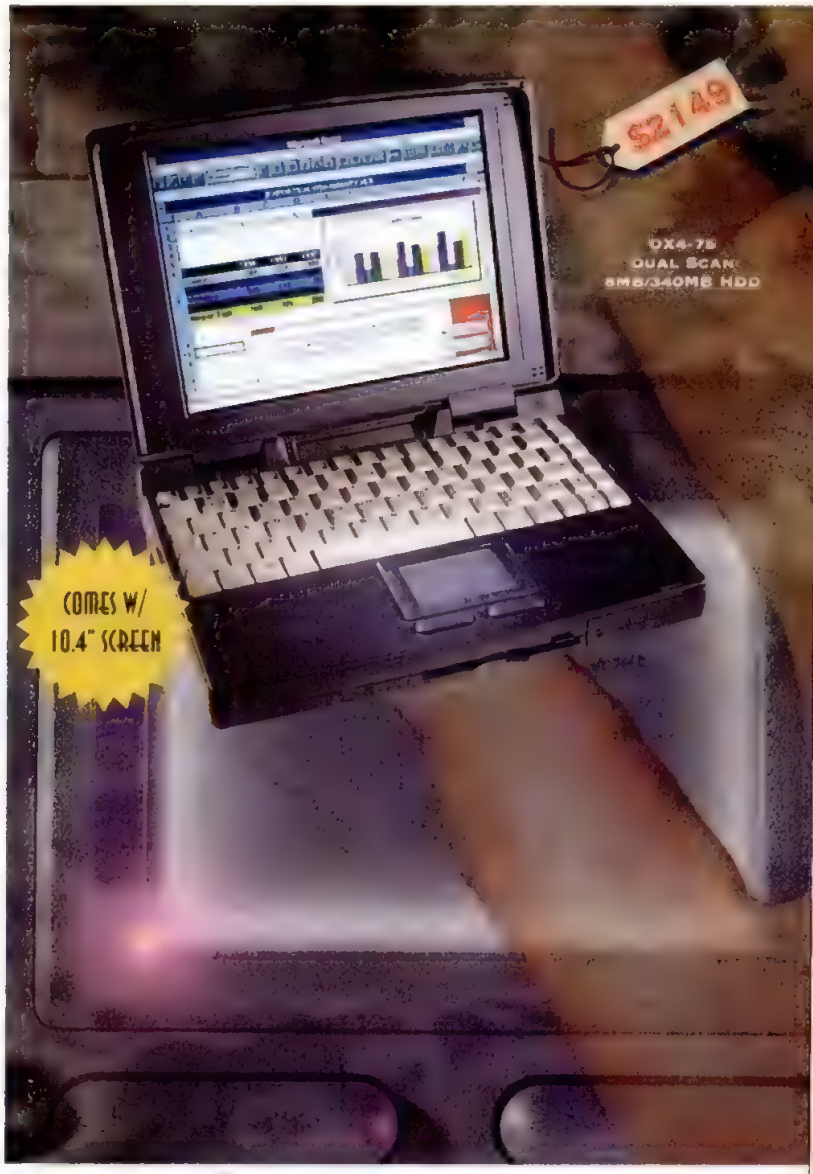

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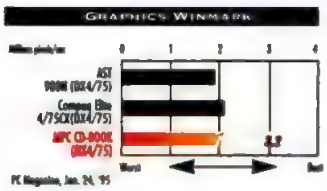

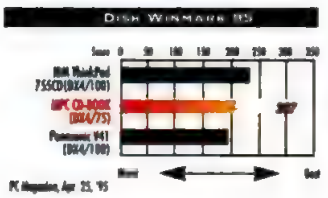

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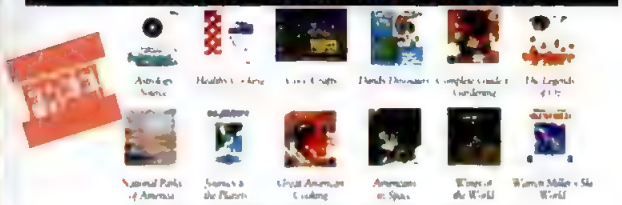

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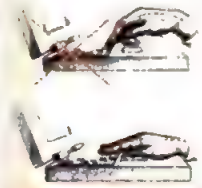

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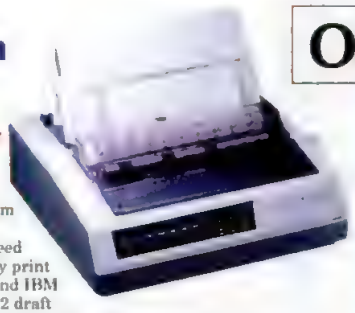

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ML321 wide carriage ..... $427.40 CDW 10515

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dot matrix printers

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ML321	wide	9	28KB buffer	300	250	63		$427.40	10515
ML520	normal	9	64KB buffer	430	320	80		$365.77	27668
ML521	wide	9	64KB buffer	430	320	80		$486.27	27670
ML590	normal	24	optional color	450	360	120		$427.71	24899
ML591	wide	24	optional color	450	360	120		$579.12	24900
ML380	normal	24	8KB buffer	240	192	63		$212.43	15526
ML395	wide	24	64KB buffer	607	486	242	162	$966.07	29571
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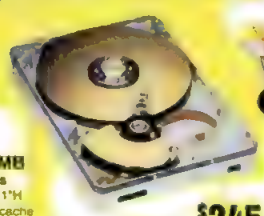

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9100MB	SCSI	MC1991AV	12ms	5.25" FH	2,299

CONNER

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1080MB	SCSI	QUEM1080S	9.5ms	3.5" 1"H	539
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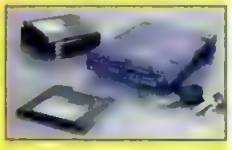

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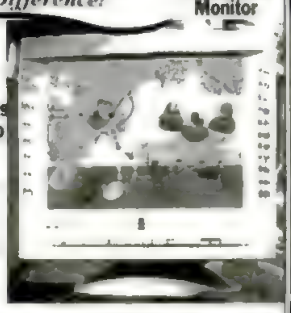

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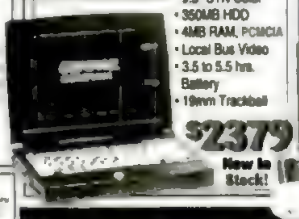

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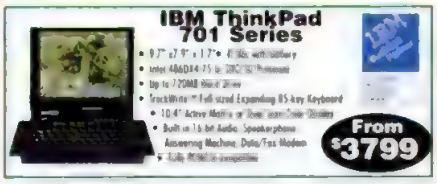

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15" MultiSync XP15 / 17" MultiSync XP17	$424/$1194
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14" CM2089/14" CM2099	$23/$2485
15" CM2015/15" CM4015	$323/$378
17" CM4018 / 20" 20CM64	$665/$1699

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Dynamite Power 2MB VLB/PCI	$194
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SpeedStar Pro SE 2MB VLB/PCI	$159
SpeedStar 64 1MB ISA*	$145
SpeedStar 64 2MB ISA*	$199
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Stealth 64 2MB VLB/PCI VRAM*	$295
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ACTION Laser 1600	$754
LX300	$164
LQ-570+/1070+	$244/$374
FX-870/1170	$287/$374
LQ-300/870/1170	$189/$454/$614
LQ-2550 Clr.	$927
DFX 5000+/8000	$1367/$2324
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PANASONIC PRINTERS

KX-P4400/P5400	$349*/$474
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KX-P4440	$989
KX-SP100 Printer/Fax/Copier	$764
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KX-P3696/P3626	$399/$389

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2390/2391 Plus Dot Matrix	$347/$439
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HP DeskJet 1200C/C PS	$997/$1587
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BJC-70/BJC-600e	$354/$458
BJC 4000	$349
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PCMCIA OPTIMA 14.4+FAX14.4	$185
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ACCURA 288V.FC+FAX int/ext	$185/$219
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MultiSpin 63i/MultiSpin 63e	$464/$554

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Sound Blaster AWE32 Value Edition	$219
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T4000M	486 DX4-75	9.5" Color Dual Scan	4MB (20)	455MB	9794062-0001	$2437
T4000M	486 DX4-75	8.4" Color Active	4MB (20)	340MB	9794061-0001	$2694
T4000M	486 DX4-75	8.4" Color Active	4MB (20)	455MB	9794061-0019	$2944
T4000M	486 DX4-100	9.5" Color Active	4MB (20)	524MB	9800253-0001	$3874
T5000	Pentium -75	10.5" Color Dual Scan	8MB (32)	524MB	9798848-0001	$4927
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PC WORLD, April 1995

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PC MAGAZINE, May 16, 1995

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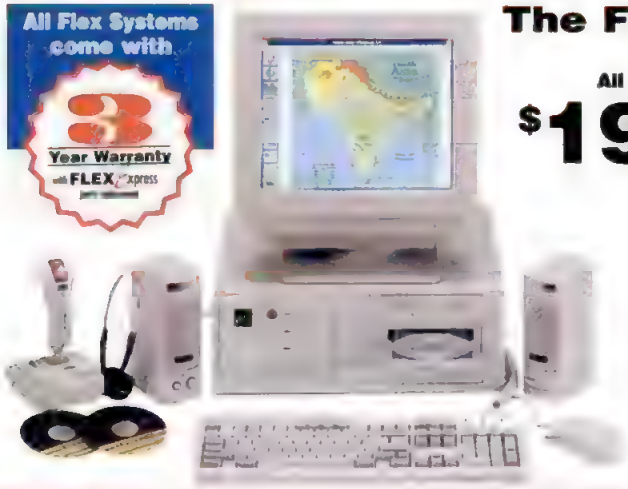

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64F0376	2Meg	90-111 311-121 321 061 101	34
64F0106	(4Meg)	90-A21 A-61 90-A31 90-111 80-311	29
64F0004	92G7196 (2Meg)	70-061 161 121 B52 355A 065A, P-70	99
		51LS 65LS, A Series 120 & 130 35SX 35LS 40SX	
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78G8955	1Meg	25	[illegible]
34F2933	4Meg	35SX 40SX 55SX 65SX 55LS 65LS	[illegible]
87F8897	92G7199 (4Meg)	50SX 55LS 65SX 40SX 35SX 35LS	[illegible]
16F1035	512K	P/S1 286	[illegible]
92F9935	2Meg	P/S1 & P/S1 386SX 2121	[illegible]
92F9894	4Meg	P/S1 & P/S1 386SX Model-2121	[illegible]
92G7230	4Meg	PS/I Expert Consultant Writer	[illegible]
92G7231	1MG (1Meg)	Value Point Performance PC Server 486	[illegible]
92G7539	4Meg)	Aptiva 310 330 350 510 530 710 730	[illegible]
92G7541	8Meg)	Aptiva 310 330 350 510 530 710 730	[illegible]
92G7543	16Meg)	Aptiva 310 330 350 510 530 710 730	[illegible]
92G7545	32Meg)	Aptiva 310 330 350 510 530 710 730	[illegible]
73G3132	92G7203 (8Meg)	Value Point Performance PC Server 486	[illegible]
60G1623	92G7204 (16Meg)	Value Point Performance PC Server 486	[illegible]
60G7205	(32Meg)	Value Point Performance PC Server 486	[illegible]
64G0902	(2Meg)	56 57 57SX 90 95 P 75 57SLC	[illegible]
		Value Point ™ 486E/I2 486SX SVR 85	
64G0128	92G7200 (4Meg)	57SX 90 95 P 75 57SLC 56 56SLC, P/61 386SX,	178.00
		Mod-2123 2133, 2156 Vir PI 77 486SX2 486SX, SVR85	
		Value Point ™ 486D/I2 486SX, SVR 85	
64F0129	92G7426 (8Meg)	35SX 40SX	339.00
64F0130	92G7202 (9Meg)	56 57 57SX 90 95 P-75 57SLC	339.00
		Value Point ™ 486D/I2 486SX, SVR 85	
64F1158	92G7708 (4Meg ecc)	486, 95XP 95A (install in pairs)	199.00
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92G7209	92G7210 (16Meg ecc)	95P95 OPP	749.00

IBM NOTEBOOK & LAPTOP MEMORY

92G7415/92G7420 (4Meg)	Thinkpad 750 C 700 C 720 C CL57SX	[illegible]
92G7416/92G7421 (8Meg)	Thinkpad 750 C 700 C 720 C CL57SX	[illegible]
86G0095 (6Meg)	Thinkpad 750 C	[illegible]
86G0094 (4Meg)	Thinkpad 755 360 355 340 450	[illegible]
86G0094 (8Meg)	Thinkpad 755 360 355 340 450	[illegible]
86G0094 (16Meg)	Thinkpad 755 360 355 340 450	[illegible]
81H8096 (4Meg)	Thinkpad 500 510CS (3.3 volt)	[illegible]
81H8099 (8Meg)	Thinkpad 500 510CS (3.3 volt)	[illegible]
81H8101 (16Meg)	Thinkpad 500 510CS (3.3 volt)	[illegible]
79F0899 (2Meg)	PS Note	[illegible]
79F1000 (4Meg)	PS Note Tepd 350 350c PS Note 425	[illegible]
79F1001 (8Meg)	PS Note	[illegible]
Hard Drive 52Meg 710 Mogb	Thinkpad 750 755, 360 355	[illegible]
(4Meg 16Meg)	Thinkpad 755 D-mate Modules	[illegible]
(4Meg 16 Meg w Adap	Thinkpad 755	[illegible]
80G0375 (8Meg)	Thinkpad 350 350c PS Note 425	[illegible]
80G0379 (16Meg)	Thinkpad 350 350c PS Note 425	[illegible]
92F0864 (2Meg)	945SL	[illegible]
92G7259 (4Meg)	Thinkpad 701C [illegible]	[illegible]
92G7261 (8Meg)	Thinkpad 701C [illegible]	[illegible]
92G7263 (16Meg)	Thinkpad 701C [illegible]	[illegible]

COMPAQ MEMORY MODULES

MODEL	AMT. UPGRADED	CMPQ PART #	PRICE
DeskPro 386/33, 386/33L 486/25, 486/33L	1Meg Module	115144-001	[illegible]
	4Meg Module	116561-001	[illegible]
486/33L Pentium Prg	16Meg Module	116566-001	[illegible]
DeskPro 386/33L, 486/33L	4 Meg Bd	116589-001	[illegible]
DeskPro 386/25, 386/20	1Meg Module	113131-001	[illegible]
	4Meg Module	113132-001	[illegible]
DeskPro 386S-16MHz	1Meg Exp Bd	113633-001	[illegible]
	4Meg Exp Bd	113634-001	[illegible]
	1Meg Module	113646-001	[illegible]
	4Meg Module	112534-001	[illegible]
DeskPro 386/20S	1Meg Exp Bd	113644-001	[illegible]
DeskPro 386/25E	4Meg Exp Bd	113645-001	[illegible]
	1Meg Module	113131-001	[illegible]
	4Meg Module	113132-001	[illegible]
DeskPro 286N, 386N, 386SX20 all "N" series system LT series, all "T" series	1Meg Module	116668-001	[illegible]
	2Meg Module	116669-001	[illegible]
	4Meg Module	116980-001	[illegible]
	8Meg Module	1288-1-001	[illegible]
M Series Exp Bd	0-8Meg	129156-001	[illegible]
DeskPro 386/16	1Meg Kit	108271-001	[illegible]
	4Meg Kit	108272-001	[illegible]
	1-2Meg Exp Bd	108069-001	[illegible]
	4-8Meg Exp Bd	108070-001	[illegible]
DeskPro 286	512K Kit	113012-001	[illegible]
DeskPro 5/60, 5/66M, 5/66M	8Meg Kit	149911-001	[illegible]
Prolinea 5/60	16Meg Kit	149849-001	[illegible]
Prolinea 100, 5/60	32Meg Kit	149912-001	[illegible]
Prolinea 2000 4/30 5/66	64Meg Kit	149913-001	[illegible]
Prolinea 4000 4/50 5/66	128Meg Kit	149914-001	[illegible]
Prolinea 386 3/25S 3/25S	2Meg	141738-001	[illegible]
	8Meg	141742-001	[illegible]
Prolinea 486 4/25S 4/33 4/50 4/66 CD6	2Meg	141663-001	[illegible]
Enhanced Prolinea, Prolinea series	8Meg	141664-001	[illegible]
	8Meg	141685-001	[illegible]
Prolinea PC Server 486/33 486 DX2/66	4Meg	141885-001	[illegible]
	8Meg	146505-001	[illegible]
	32Meg	149147-001	[illegible]

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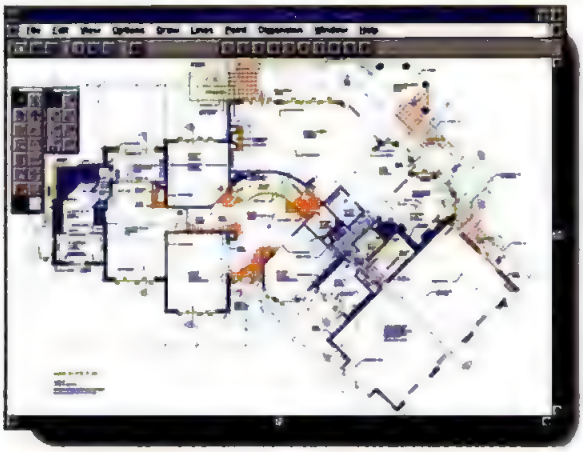

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CFS420A	420 mb	12 ms	3.5" IDE	175
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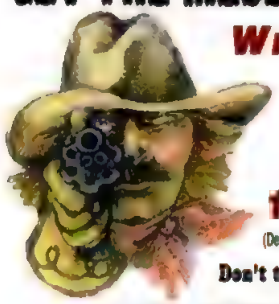

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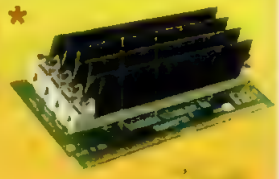

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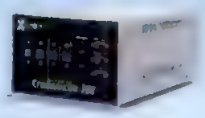

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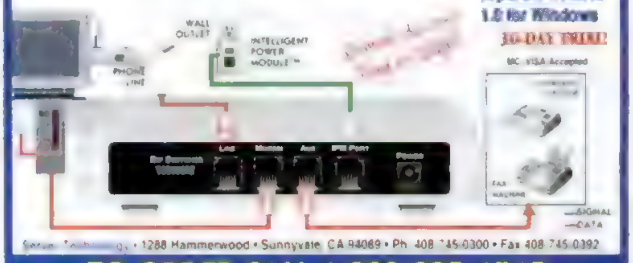

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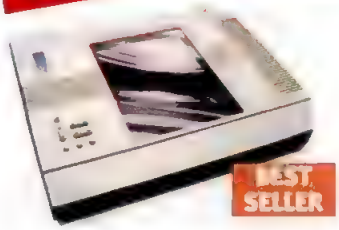

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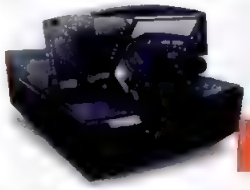

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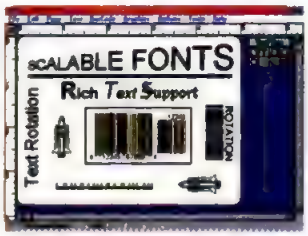

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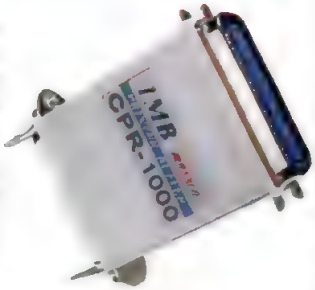

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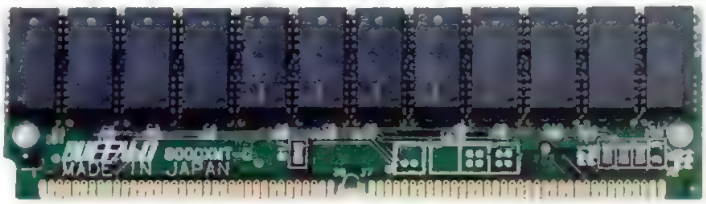

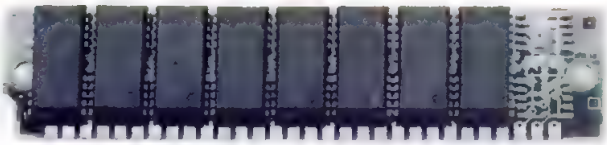

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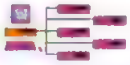

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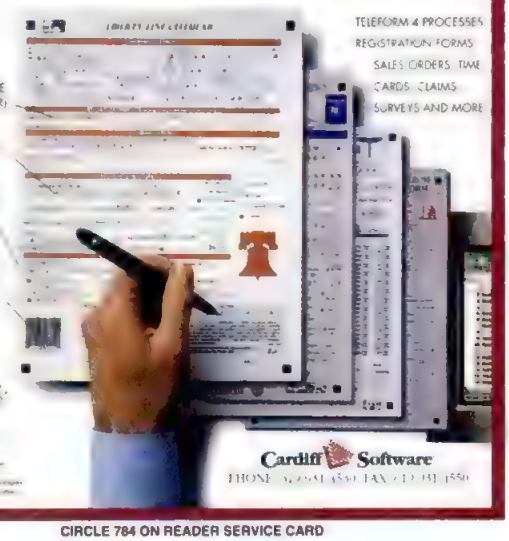

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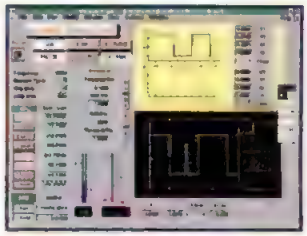

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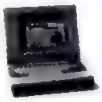

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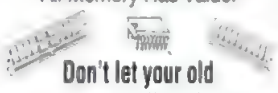

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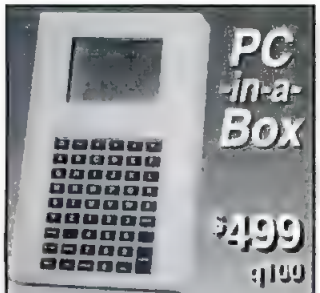

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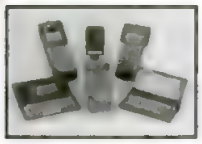

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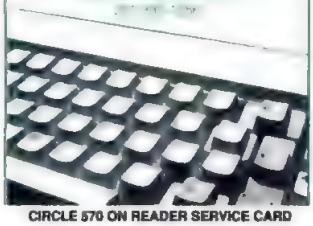

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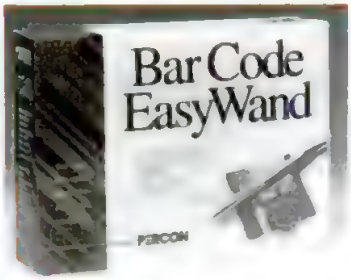

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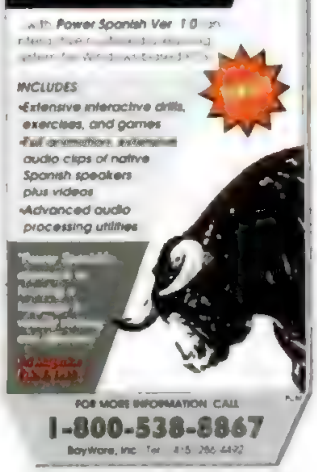

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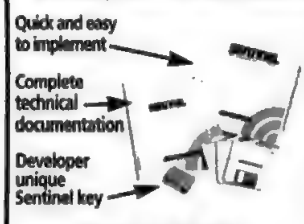

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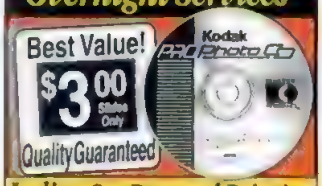

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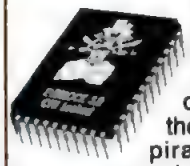

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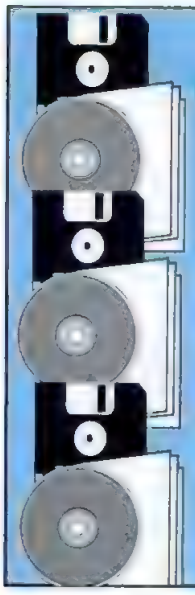

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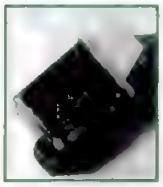

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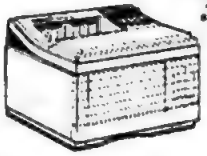

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PC MAGAZINE

Coming Up

The Perfect PC

Our annual compendium crystallizes everything you need to know about hardware and PCs. We show what to look for in the perfect desktop PC—from entry-level to no-holds-barred—as well as the perfect notebook and server.

INSIDE THE PERFECT SYSTEM UNIT What are the features that go into the perfect system unit? We'll tell you about expandability, security, motherboard components, and more.

INSIDE THE PERFECT DISPLAY We describe the ideal graphics accelerator and display combination for various users, explain how the components work, and update you on important specifications and new technologies.

INSIDE THE PERFECT HARD DISK How much disk capacity do you need? What's the right disk interface? How does 32-bit disk access differ from 32-bit file access? Whatever your questions, we'll help you sort them all out.

INSIDE THE PERFECT MULTIMEDIA ADD-ONS We define the criteria that distinguish the perfect multimedia components from the merely passable. Find out how you can tailor a multimedia system to suit your needs.

BUILDING THE PERFECT NETWORK Whether you're building an enterprise network or connecting a workgroup, we detail what to look for in every network component—from the perfect network adapter to the perfect NOS.

THE PERFECT INTERNET CONNECTION We look at four options for hooking into the Net, describe our vision of a software tool for navigating the Net, and anatomize the emerging boom of publishing electronically on the Internet.

The PC Magazine 200

We tabulate financial and corporate data for the 200 largest PC, peripheral, networking, and software vendors to tell you more about the companies that stand behind the products we review.

Our Latest Reader Surveys

We've polled our readers to find out how PC vendors measure up when it comes to service and reliability and how software vendors fare in terms of user support and satisfaction.

PC Magazine At Home

The latest crop of inexpensive color ink jet printers can go a long way toward making your home a more colorful place. We put ten of them through their paces to assess color and gray-scale output, as well as ink cartridge life. With all these printers priced below $600, you'll wonder why you're still printing in black and white.

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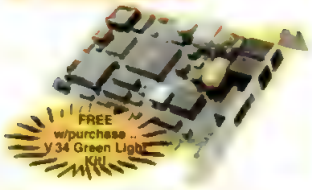
MODEMS

U.S. Robotics



Sportster 14.4/14.4 Internal Modem MBUSR0276 **$99**

U.S. Robotics

Sportster 14.4/14.4 Int. Fax/Modem	$99
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UPS

APC

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20", 20CM64, .31, 1280x1024, N.I. CMMA20CM64	1,099

mag INNOVISION

17" Monitor
- .31 dot pitch
- 1024x768 resolution
- N.I.

CMDX17 **$639**

mag INNOVISION

15", DX15FE, .28, 1280x1024, N.I. CMDX15FE	$339
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17", DX17, .28, 1280x1024, N.I. CMDX17	639
17", MXP17F, .28, 1600x1280, N.I. CMMXP17F	689
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CTX

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PRINCETON

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15", Ultra 15, .28, 1280x1024, N.I. CMPGU15	349
17", Ultra 17, .28, 1280x1024, N.I. CMPGU17	629

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- [illegible] MDD
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- Accupoint™ integrated pointing device
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MAT215@CDT **$3,719**

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Canon

BJ-70 Portable Color Bubble Jet 720 dpi 346 CPS	$359
BJ-200EX Bubble Jet 720 dpi 248 CPS	235
BJC-4000 Color Bubble Jet 720 dpi 446 CPS	355
BJC-600E Color Bubble Jet 720 dpi 240 CPS	469
LBP 1260-Laser 600 dpi 12ppm 2MB	1,289

HEWLETT PACKARD

HP LaserJet 4L 4 ppm Laser 300 dpi 1MB	$509
HP LaserJet 5P 600 DPI Laser 6ppm 2MB	959
HP DeskJet 320 Portable Ink Jet 3ppm 600 dpi	299
HP DeskJet 540 Ink Jet 3ppm 600 dpi	289
HP DeskJet 1200CS 600 dpi 7ppm 2MB	979
HP DeskJet 1200PS 600 dpi 7ppm 4MB	1,579

OKIDATA

ML380 Dot Matrix 24-pin 340 CPS narrow	$215
ML 590 Dot Matrix 24-pin 450 CPS narrow	425
OL400E LED 300 dpi 4ppm 512k	409
OL410E LED 600 dpi class 4ppm 2MB	539
OL810 LED 300 dpi 8ppm 2MB	909
OL850 LED 300 dpi 8ppm 2MB	1,239

TEXAS INSTRUMENTS

MicroWriter PS23 LED 300 dpi 5ppm 2MB	$619
MicroLaser 600 600 dpi 5ppm 2MB	839
MicroLaser Pro 600 PS23 600 dpi 8ppm 3MB	1,179
MicroLaser Pro E 600 dpi 12ppm 3MB	1,349
MicroLaser Power Pro 600 dpi 12ppm 6MB	1,479*

*With $125 Manufacturer's Rebate - ends 6-30-96

EPSON

LQ-300 Dot Matrix 24-pin 240 CPS narrow	$199
LQ-570+ Dot Matrix 24-pin 225 CPS narrow	249
Stylus 800+ Inkjet 360 dpi 250 CPS	219
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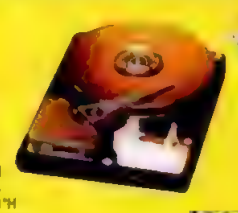

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850MB	IDE	WD2850JA	10ms	3.5" 1"H	245
1080MB	IDE	WD3100JA	10ms	3.5" 1"H	349
1280MB	IDE	WD3120JA	10ms	3.5" 1"H	375
1620MB	IDE	WD3180JA	9ms	3.5" 1"H	569

CONNER

Capacity*	Interface	Model	Access	FF/Height	Bare
425MB	IDE	CFS425A	14ms	3.5" 1"H	$175
541MB	IDE	CFA540A	14ms	3.5" 1"H	195
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850MB	IDE	MX7850AV	12ms	3.5" 1"H	259
1280MB	IDE	MX71280AV	12ms	3.5" 1"H	395

Quantum

Capacity*	Interface	Model	Access	FF/Height	Bare
420MB	IDE	QULT420A	12ms	3.5" 1"H	$189
540MB	IDE	QULT540A	11ms	3.5" 1"H	219
730MB	IDE	QULT730A	11ms	3.5" 1"H	249

Seagate

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MICROPOLIS

Capacity*	Interface	Model	Access	FF/Height	Bare
2100MB	SCSI	MC4221S	8.5ms	3.5" 1"H	$999
2100MB	SCSI	MC4221AV	8.5ms	3.5" 1"H	1,059
4300MB	SCSI	MC3243S	8.5ms	3.5" HH	1,339
4300MB	SCSI	MC3243AV	8.5ms	3.5" HH	1,439
9100MB	SCSI	MC1991	12ms	5.25" FH	2,199
9100MB	SCSI	MC1991AV	12ms	5.25" FH	2,299

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Capacity*	Interface	Model	Access	FF/Height	Bare
1080MB	SCSI	CFP1080S	11ms	3.5" 1"H	$499
2147MB	SCSI	CFP2105S	8.5ms	3.5" 1"H	899
2147MB	SCSI	CFP2107S	8.5ms	3.5" 1"H	999
4294MB	SCSI	CFP4207S	9ms	3.5" HH	1,579

Quantum

Capacity*	Interface	Model	Access	FF/Height	Bare
540MB	SCSI	QULT540S	11ms	3.5" 1"H	$229
730MB	SCSI	QULT730S	11ms	3.5" 1"H	249
1080MB	SCSI	QUEM1080S	9.5ms	3.5" 1"H	539
1440MB	SCSI	QUEM1400S	9.5ms	3.5" 1"H	739
2150MB	SCSI	QUEM3125S	8ms	3.5" 1"H	989
4280MB	SCSI	QUGP4280S	8.5ms	3.5" HH	1,529

Seagate

Capacity*	Interface	Model	Access	FF/Height	Bare
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1052MB	SCSI	ST31230N	9ms	3.5" 1"H	499
2100MB	SCSI	ST32430N	9ms	3.5" 1"H	899
2134MB	SCSI***	ST12450W	8ms	3.5" HH	1,425
2139MB	SCSI***	ST32550W	8ms	3.5" HH	1,099
2145MB	SCSI**	ST32550N	8ms	3.5" 1"H	999
4294MB	SCSI**	ST15150N	8ms	3.5" HH	1,439
4294MB	SCSI	ST15230N	9ms	3.5" HH	1,259
4294MB	SCSI***	ST15150W	8ms	3.5" HH	1,529
9080MB	SCSI	ST410800N	11ms	5.25" FH	2,999

*Capacities based upon manufacturer's quoted capacity where 1MB=1,048,576 bytes **Barracuda Drive ***68 Pin Wide SCSI Drive

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After Hours

EDITOR'S RATINGS: ★ Poor ★★ Fair ★★★ Good ★★★★ Excellent

DOS Windows CD-ROM Resource-Intensive Adult Content Kids (Ages) Price

Virtual Travel Agents: Trip Planners on CD-ROM

Too many, the headaches involved in planning a vacation by car can take all the fun out of getting away. You have to try to decipher your dated maps and figure out which way would be the quickest—and which hotels, restaurants, and attractions are along the way.

But thanks to the latest slew of trip-planning software, you can get a travel agent in a box who'll figure out all the boring details for you, even calculate down to the minute how long it's going to take you to get from here to there. After using these titles, you'll wonder how you ever managed to survive a vacation without them.

Map 'n' Go

DeLorme Mapping; 800-227-5931.

Circle 469 on reader service card

★★★★ $49.95

Though definitely lacking in the interface department, this trip planner more than makes up for it with superior detailed information. With access to over a million miles of road, you'll get the most alternative routes offered by any trip planner. Like Rand McNally's TripMaker, Map 'n' Go will calculate the shortest and quickest routes, but it allows you to customize even more. You can select speeds for up to eight different types of roads so you can accurately factor in traffic or the drag caused by pulling a trailer. But the best part of the program is its database of restaurants, motels, and campgrounds, so you can see at a glance the towns along your route that have the facilities you desire.

Map 'n' Go offers pictures and audio narration of your favorite tourist spots.

Map 'n' Go will also pull up attractions along the way, taking into consideration how many miles off the path you're willing to go. Select a point of interest and you get audio narration and a photo. Though the database is not as extensive as the one in TripMaker, Map 'n' Go covers all the major attractions.

Map 'n' Go's biggest drawback is that it calculates stopovers in the order you entered them as opposed to the order along your route. But minor flaws aside, the combination of detailed maps and a database of restaurants and hotels make this one of the best travel planners, even if its informational displays could be improved.

Rand McNally's TripMaker

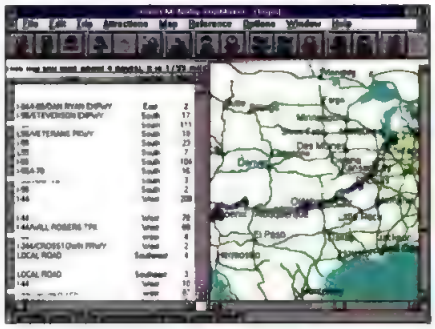
Rand McNally; 800-671-5006.

Circle 470 on reader service card

★★★★ $49.95

The folks who put road atlases on the map deliver a powerful trip planner that is the epitome of user-friendly. Creating a travel plan couldn't be easier, thanks to the TripMaker Guide, which takes you step by step through the process by asking for your starting and ending points, whether to take the quickest or most scenic route, and even how fast you plan to drive. After a few minutes, the program spits out a detailed map showing your selected path and a detailed itinerary that tells you exactly which roads to take and how long you'll be on them.

Naturally, if you're planning a trip outside your area code, you can factor in stopovers. Tell the program just how many hours you want to put in behind the wheel and TripMaker will tell you which town is closest to your planned stopping point. If you would like to see some interesting sights along the way, TripMaker's unrivaled database can pull up all



Rand McNally's TripMaker generates a detailed itinerary for your driving trips.

AFTER HOURS INDEX

Travel Planners on CD-ROM
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Expert Travel Planner CD 360
AAA Trip Planner 362
CD-ROM Pick Hit
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Quick Clips
ClockWerx
Expert Movie Clips Screen Saver
Take Your Best Shot
Wild Cards 362
Spotlight on Action
Dark Forces 365
Action
Heretic 365

points of interest along your route. Once you're satisfied with your trip, print out your map and itinerary and you're all set for the best vacation your family has had in years.

The one disappointment is that the program does not have any listing of restaurants and motels for the places you'll be passing through, other than a national directory of telephone numbers. But if ease of use and attractions are your biggest concerns, then TripMaker is the travel agent of choice.

PROBLEM SOLVER

Don't be confused when a trip planner gives you the option of taking the *quickest* route or the *shortest* route. The shortest route is measured in miles; the quickest route is measured in time.

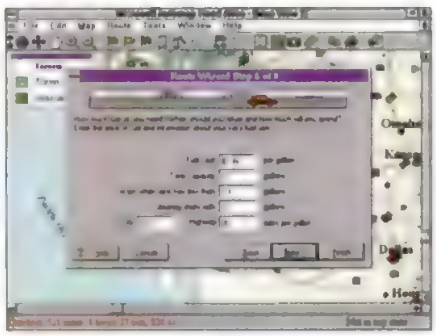
Microsoft Automap Road Atlas

Microsoft Corp.; 800-426-9400.
Circle 471 on reader service card
★★★ WIN $29.95

Like Rand McNally's TripMaker, Microsoft Automap Road Atlas has a trip-planning automator—here called a Wizard—that asks you to decide the nature of your journey, then custom-tailors a route to meet your traveling style. Here, though, you have more choices for customizing your trip. One of the unique choices is the ability to specify refueling stops. After it asks the size of your gas tank and how many miles per gallon your car averages, Automap locates the gas stations at which you'll need to stop along the way to ensure that you don't find yourself out of gas and 100 miles from the nearest gas station.

The program's driving instructions are the easiest to follow from any of the travel planners. Directions are given in plain English, so you know to "turn left onto US101." There are also detailed articles about all the states that provide a wealth of information, from the state bird to a chart that explains the state's demographics.

The main problem with Automap is that the maps are too detailed. You can easily get lost on a map that has icons for every park and attraction on it, many of which are covered over by several other icons. And to get to the pictures of such locations, you need to click on an icon that is often covered up by something else. Also, with only 400,000 miles of road, you'll get considerably fewer alternative routes than with Map 'n' Go. Last, there is no listing of restaurants and hotels along the way, which makes Automap another title that promises the best vacation but leaves you a little hungry.



Microsoft Automap Road Atlas's gas-station locator will make sure you don't get stranded on Empty in the middle of nowhere.

Expert Travel Planner CD

Expert Software; 800-759-2562.
Circle 472 on reader service card
★★ WIN $14.95

For less than you'd pay for a dinner for two on your vacation, you can get this title and its limited but useful features.

The program is simple to use: You type in your starting and ending points and it calculates the shortest or the quickest path, factoring in your driving speeds for eight different road types and any stopovers you specify. The itinerary it generates is simple yet effective, and the maps contain an amazing amount of user-controlled detail.

Expert Travel Planner CD also includes more than 100 animations and full-motion video clips of the states and big cities of the U.S., as well as audio help for those who are too lazy to read the instructions.

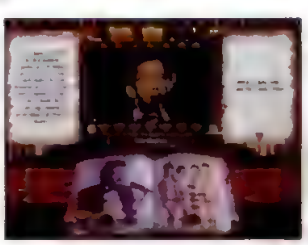
Unfortunately, it does lack many of the features of the pricier models, such as the ability to show attractions, restaurants, gas stations, or lodging along the way. All the program offers along those lines is a list of motel chains, car-rental agencies, and airlines.

If you want a trip-planning title but are pinching pennies, this may be the program you need. Just remember that you get what you pay for.

Expert Travel Planner CD provides only basic routing capabilities.

The Grammys

CD-ROM PICK HIT



Now you can experience the excitement of the Grammy awards show, without having to endure the boring speeches. Along with a database listing every nominee and winner for the last 35 years, this CD-ROM provides over 40 minutes of performances, interviews, and behind-the-scenes footage. There's a trivia game that tests your Grammy expertise and a recording studio that lets you edit your own short Grammy show. If you never miss a Grammy ceremony, you won't want to miss this CD. —Shane Mooney

Mindscape; 415-883-3000.
Circle 475 on reader service card
★★★★ WIN $59.95

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CIRCLE 050 ON READER SERVICE CARD

AAA Trip Planner

Compton's New Media; 619-929-2500.

Circle 473 on reader service card

★ $58.95

The main attraction of this CD-ROM is its listing of more than 34,000 AAA-approved restaurants, attractions, and hotels. To get a listing of restaurants that meet your criteria, simply input how much you want to spend per plate and how high a "diamond rating" you want for the establishment. There are several multimedia slide shows, as well as articles on the economy and recreational prospects of your chosen state.

Unfortunately, there's not much in the way of trip-planning functionality. All you can do is enter your starting and ending points and accept the route the program selects. You're given no choices for alternative routes and no options to set your speed or driving habits. And even though it has a large database of restaurants, hotels, and attractions, AAA Trip Planner tells you only which ones are in your state, not along your route.—*Shane Mooney*

AAA Trip Planner doesn't allow you to choose alternative routes.

QUICK CLIPS

Recommended · It's Your Call · Not Recommended

ClockWerx

The latest offering from the Tetris crew is a clock-based puzzle game so addictive that this column almost didn't get finished. Buy this one and watch your productivity go down the tubes. *$26.95; Spectrum Holobyte; 800-695-4263.*

Expert Movie Clips Screen Saver

The ability to combine 200 movie clips into your own PC production may appeal to the Cecil B. DeMille lurking within you, but these tiny, anonymous flicks won't win you an Academy Award. *$19.95; Expert Software; 800-759-2562.*

Take Your Best Shot

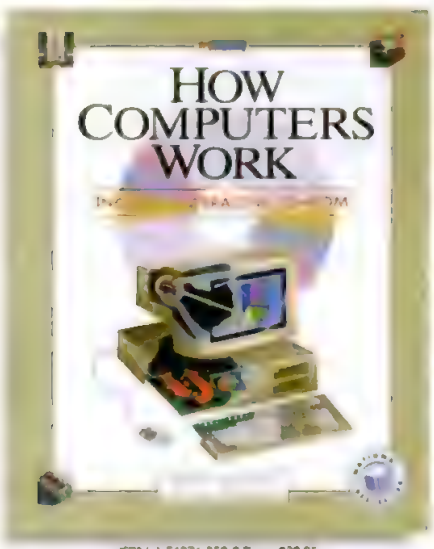
How can you resist a CD-ROM that serves up twisted variations on arcade favorites Pong, Breakout, and baseball, all illustrated by MTV cartoonist Bill Plympton? *$19.99; 7th Level; 214-437-4858.*

Wild Cards

This beautifully animated CD-ROM of kiddie card games will keep you from ever having to play another hand of Old Maid with Junior, but it's cheaper to just shut up and deal. *$39.95; Corel Corp.; 800-455-3169.*

Click Click.

PC/Computing How Computers Work CD-ROM/Book extravaganza from Ziff-Davis Press.



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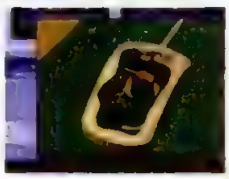

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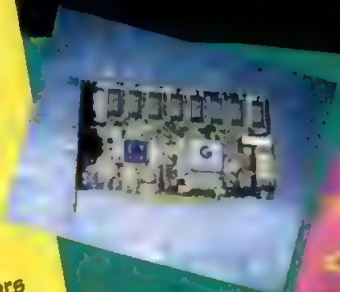

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SPOTLIGHT ON ACTION

Alone Against the Empire: Dark Forces

Welcome to Dark Forces. You are Kyle Katarn: rogue, mercenary, and part-time special agent of the Rebel Alliance. It's your mission to eliminate the Empire's latest doomsday weapon—the Dark Troopers. A handful of these flying robotic nightmares already took out an entire planet, so if you fail, the Alliance is doomed.

As this first-person Star Wars action game begins, you must steal the plans for the original Death Star. Having accomplished that, you move on through a 13-mission campaign to find and destroy the Dark Trooper construction facilities. You can't simply shoot your way through these missions. Instead, you have to solve complex adventure game–style puzzles, many of which can leave you guessing for hours on end.

Each of the missions unfolds in a large, intricately designed world. The worlds can range from a gurgling sewer system to Darth Vader's flagship. Along the way, your foes include endless waves of Storm Troopers, piglike Gamorrean Guards, and two deadly versions of the Dark Trooper.

The graphics are outstanding—possibly the best in the genre. The sound and John Williams–inspired musical score are beyond compare, especially if you have a wavetable sound card. Dark Forces is not for everyone, however. To begin with, you can't save the game in the middle of a level—once you start a mission, you have to finish it. Also, there's no multiplayer support. Finally, the game ends all too quickly. With only 14 levels—difficult as they are—you may need to play on the highest difficulty setting to get your money's worth.

—Michael Ryan

LucasArts Entertainment Co.; 415-721-3300.

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Action

Middle-Age Mayhem

Heretic

Id Software; 800-434-2637.

Circle 474 on reader service card

★★★★ $40.00

As you stand at the gateway to the City of the Damned, armed with your elven-wand and staff, you hear a strange batlike screech. As you step forward to investigate, you realize your mistake. Too late! The source of that hideous screech is upon you, deadly talons tearing at your flesh. You are the hunted, the hated, the outsider. You are the Heretic.

Id Software and Raven Software have joined forces to bring you the latest combat action game, Heretic. This supernatural adventure serves up the 3-D game play of DOOM with the addition of improved graphics and some new capabilities, all wrapped up in a medieval village run amok. You can look up and down, fly through the air, and turn your opponents into clucking chickens. In some cases, you will find yourself swimming upstream, battling the currents and your enemies like a blood-crazed salmon. All of the settings and characters are clearer and more detailed than those in DOOM.

Your mission is to wipe out the disciples of the Order of the Sign, who are responsible for the destruction of your leaders, the elders of Sidhe. Along the way you will be confronted by gargoyles, undead warriors, Ophidians (creatures that are half snake, half human) and wizards, among other foes. There are many obstacles along the way, such as erupting volcanoes, lava pits, and gas pods. Wind, water currents, and ice floes make the going tough. Be careful, for as you near the end of each level, a Boss Monster is waiting to show you who's the real boss.

Be on the lookout for precious weapons and magical items to add to your arsenal. The Crossbow, Hellstaff, and Phoenix Rod are formidable weapons. Artifacts such as the Mystic Urn, the Tome of Power, and Valador's Ring of Invulnerability will aid you in your quest. Or detonate Delmintalitar's Time Bomb of the Ancients and run away as fast as you can.

Heretic provides five levels of difficulty to ease you into the action, and it has a network option that allows up to four players to compete either cooperatively or in deathmatch mode. If you've got the guts, grab a Phoenix Rod and roast a few bad guys.

—John Delaney

Heretic serves up DOOM-like 3-D action in an eerie Middle-Age setting, complete with flying wizards and dank dungeons.

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

Driving at the Speed of Light

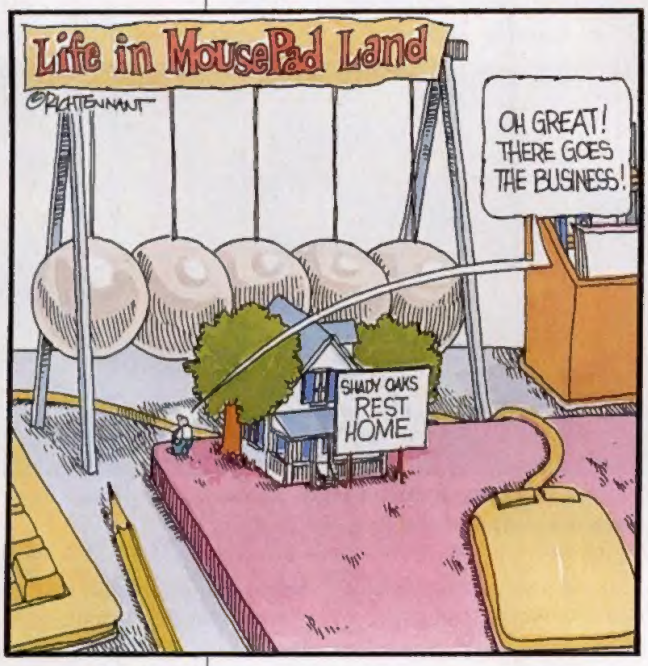
The helpful audio narration on Janus Interactive's License to Drive, a driver-education CD-ROM, includes this piece of advice: "Remember, you can't see as well at night, so slow down. Don't drive beyond the range of your headlights."

Now this is truly weird: Can anyone explain why the photos included in advertisements for DataFocus and TEAC America are so shockingly similar?

Any Time, Bill, Any Time

Eight issues ago, we reported that a lecture by Microsoft CEO Bill Gates—scheduled for November 1994 at New York's 92nd St. YM-YWHA—had been postponed until February. The following update was recently sent to Y members: "It is impossible for us to get a new confirmed date. . . . It is with regret that we are postponing this event until the fall."

Now *that's* the perfect office! This Novell/WordPerfect ad was photographed in the rooftop bar of the San Francisco Marriott. Cheers!



Richard Tennant

Hey, It Ain't as Bad as Some Of the Others

America Online continues to produce amusing randomly generated passwords in its trial packs. The latest one to cross our desk: *DOWNED-DRAINS.*

American Microsystems of Seattle offers this exciting premium when you buy a new PC.

If your entry is used, we'll send you $50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine,* One Park Ave., New York, NY 10016-5802. Winners this issue: Bob Atkinson, Tara Denny, George Kovatch, Joseph Matthews, and Jordan Triebwasser.

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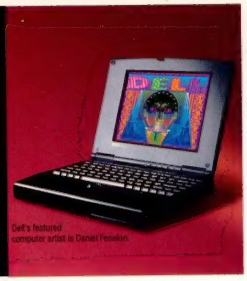

Dell's featured computer artist is Daniel Feinstein.

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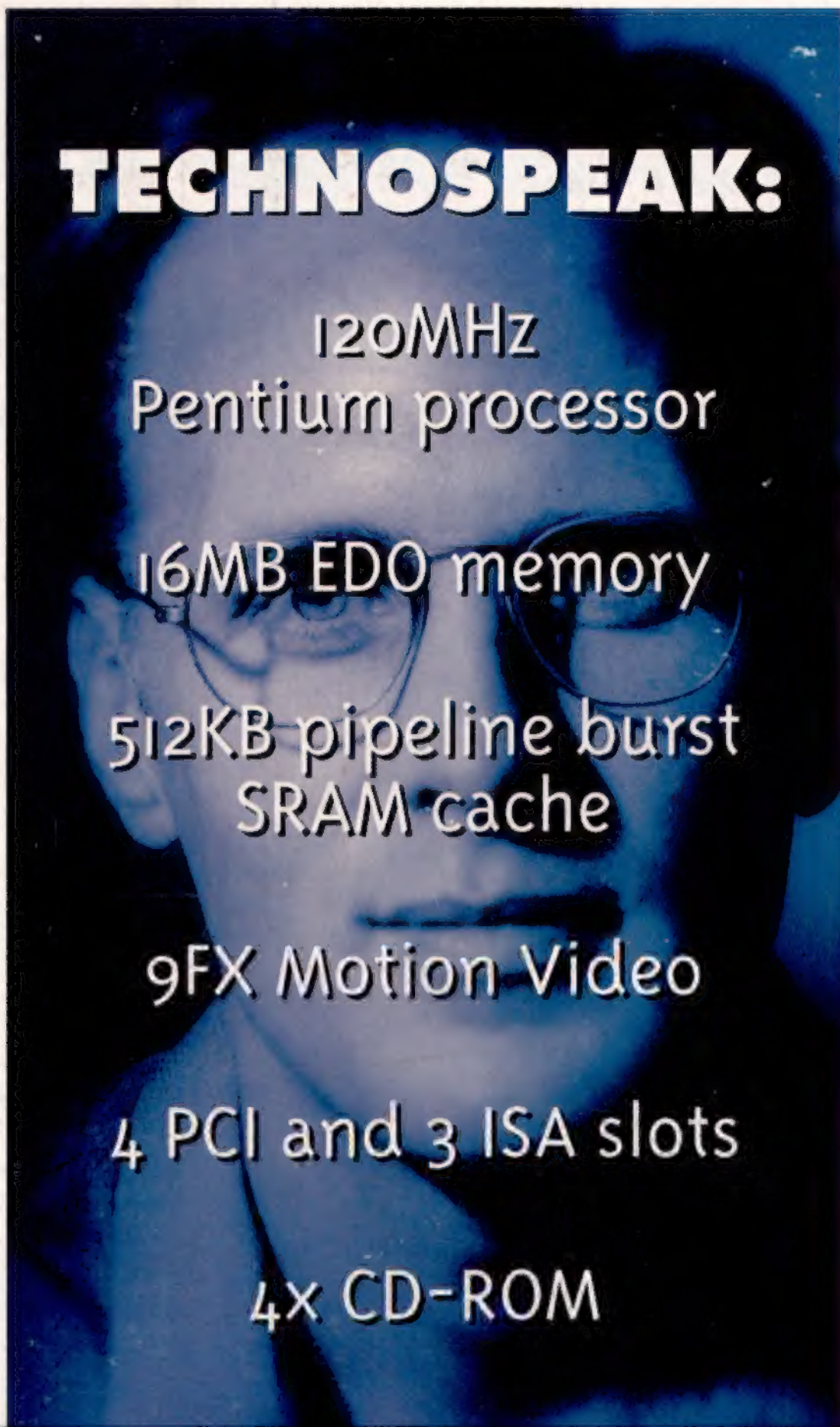

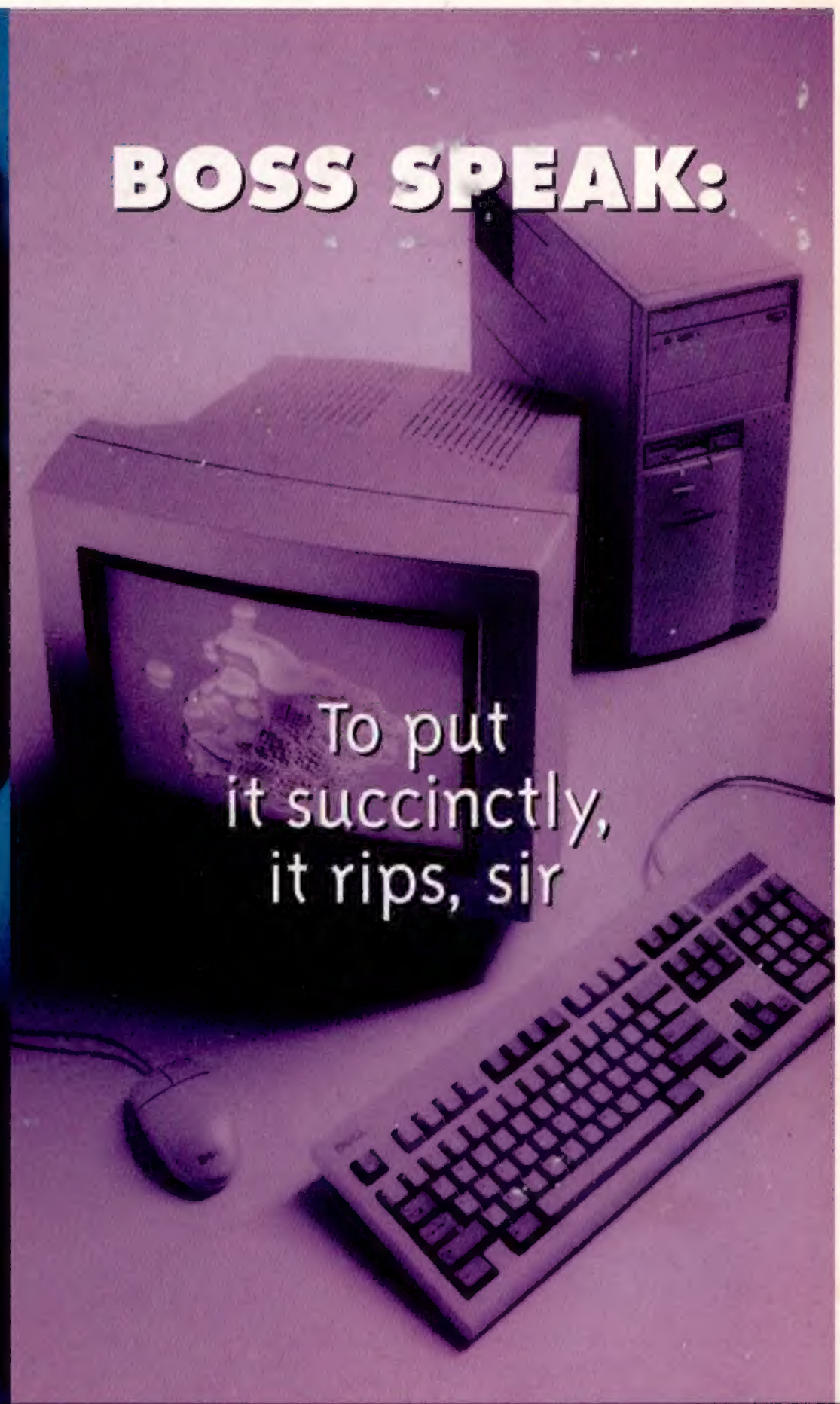

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